

The New Zealand Journal of Agriculture.

VOL. XXXVIII.

WELLINGTON, 20TH MAY, 1929.

No. 5.

A SURVEY OF PUMICE SOILS.

(Series continued.)*

THE SUBSOILS OF ROTORUA COUNTY.

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IN presenting the results of the analyses of the subsoils of Rotorua County in map form it will be profitable to discuss the meaning allotted to the terms "soil" and "subsoil" by various writers—since these terms are by no means always used in the same sense—and to define in what sense the terms are used in these articles. The top samples of this Rotorua Survey have always been taken to a uniform depth of 9 in. from the surface with a borer or auger, and are designated the "soil." Samples taken to a further depth extending from 9 in. below the surface to 18 in., and therefore representing the second stratum of 9 in. below the first, are termed the "subsoil."

The word soil is often used by agricultural writers to include both the soil and the subsoil. Woodward makes the important observation that the so-called soil maps of the United States, Germany, &c., are in reality subsoil maps with indications of the nature and depth of the soil at particular spots. The same word is also used in a special sense when referring to that portion of the soil which is cultivated by the plough, anything below this being termed the subsoil. The word subsoil may also be used in a general sense to indicate any layer of material, even rock, lying beneath the portion known as the soil. The term, however, is more generally used to include all that weathered material derived from rock, and having a soil-texture and a mechanical composition similar to that of the soil, but differing fundamentally from the soil in not containing the life or the remains of life (organic matter or "humus") which the soil contains, and which is the final ingredient in the evolution of a soil from the parent rock necessary to convert the unproductive lifeless mass into a fertile medium for the growth of crops.

Thus in its chemical composition, in addition to organic matter, the soil is richer than the subsoil in the mineral plant-food phosphoric

* The last article of this series appeared in the *Journal* for August, 1927.

acid, which by the aid of life tends to ascend from the subsoil strata to the soil, where it becomes fixed and is only removable by cropping or feeding off, but not, in normal soils, by leaching. The subsoil may be richer in other mineral foods such as potash and lime, but is always poorer in nitrogen. As regards physical composition or texture the soil in temperate climates is usually poorer in the finer particles than the subsoil; that is to say, the finer portions of the soil, such as those classified as silts and clay, are gradually washed down into the lower strata and become caught in the subsoil or carried into drains and ditches in the run off. This effect tends to be balanced in old pastures by the influence of worms bringing fine soil to the surface, and, on the contrary, is increased in garden-soils by constant cultivation.

As life flourished in and on the surface soil long before it was cultivated or "broken in," the remains of all forms of bacteria, diatoms, infusors, and other microscopic plants and animals, together with macroscopic animals such as worms and other forms of animal life, decayed in the soil, while the remains of the higher plants decaying darkened the soil in colour. These processes greatly increase the nitrogenous contents and provide that most valuable form of organic matter which is universally known by the indefinable term "humus."

As has been stated before in these articles, the recent volcanic air-distributed types of soil and subsoil of Rotorua County differ fundamentally from other soils. On the physical side they differ in (1) method of distribution, (2) comparative youth, (3) comparative absence of colloids or jelly-like substances such as clay and humus, and (4) extreme porosity and looseness of texture, the individual particles also being extremely porous. They have also the unusual feature that the surface soil, as a rule, is finer in texture than the subsoil, which latter increases in coarseness with increasing depth, contrary to what is usually found in normal agricultural soils.

On the chemical side these recent volcanic soils (so recently formed from the parent acid igneous rocks, rhyolite or rhyolitic pumice or tuff), exhibit the defects in chemical composition inherent to a soil derived from an acidic parent rock. Thus they (1) are deficient in bases, except potash, manganese, and possibly copper, which appear to be present in amounts exceeding those of ordinary soils; (2) contain an excess of acidic mineral compounds, especially silica (or silicic acid) as a solid and in solution in the soil water; (3) are deficient in organic matter and clay components.

Under (1) it is fortunate that carbonate of lime is absent from these coarse pumice soils, the sandy silts, and the fine gravelly and sandy types of pumice, for it has been amply proved that the application of ground limestone to these soils has a deleterious effect on the feeding-value of the pasture, judged by the actual effects on ruminants. Stock became "bush sick" within a shorter period on a limed paddock than those pastured on the control area which had received no manurial or lime top-dressing. The writer would earnestly warn any who may contemplate applying quicklime or carbonate of lime (ground limestone) to pastures on the coarse pumice "bush sick" soils of the types mentioned that such treatment may hasten the onset of the malnutrition disease in their stock. If calcium applications, additional to those supplied in the usual phosphate fertilizers, are deemed necessary,



FIG. 1. RAUPO (*TYPHA AUGUSTIFOLIA*) SWAMP NEAR TE NGAE.

Excess of water here has resulted in the formation of deep deposits of organic matter. A comparatively recent layer of air-borne volcanic ash now forms the immediate subsoil, and facilitates drainage when the main drain is cut to remove excess of water in the lower subsoil strata.

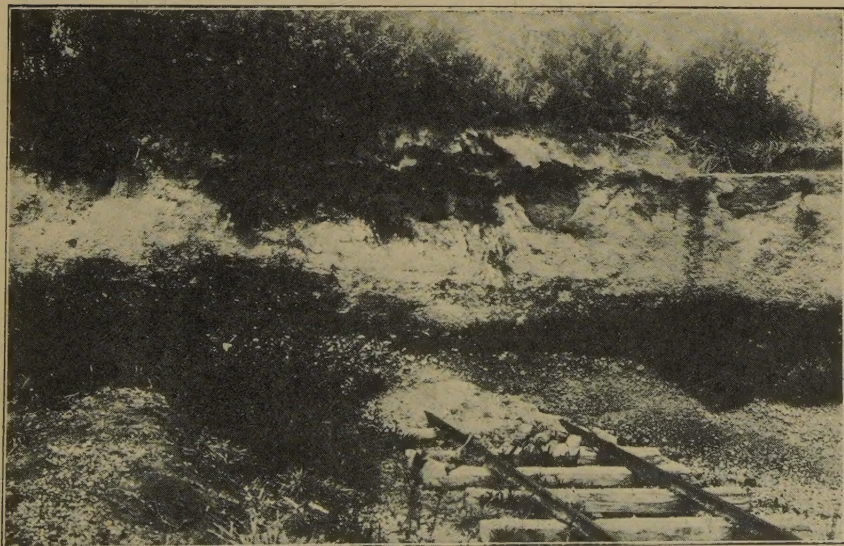


FIG. 2. SECTION OF PUMICE SOIL AND SUBSOIL STRATA, 9 FT. DEEP, IN QUARRY AT ROTORUA.

Here may be seen manganese and iron oxides leached out of the finer upper layer of soil and subsoil into the coarser subsoil stratum at the foot of the section.

[Photos by B. C. Aston.]

the extra calcium should be applied in a non-alkaline form such as gypsum or land-plaster (hydrated sulphate of lime). This mixes well with either sulphate of iron, superphosphate, or both. Superphosphate contains a large proportion of sulphate of lime (60 per cent.), and its application to pumice lands is always beneficial.

The influence of the subsoil on the soil is paramount, for the texture of the subsoil strata determines the water content of the soil, which is one of the great factors in soil-fertility. For every type of soil there is an optimum content of water, which is greater or less according to the structure of each type. Thus quartz sandy soils require the least water, loams more, clays still more, and organic soils, peats, &c., the most water. As the water content is greater or less than the optimum, so is the response of the vegetation or crop in the quality and quantity of its growth. With increasing deficiency of water the final stage is barrenness due to drought, and desert conditions then prevail. With increasing excess of water marshy or stagnant conditions ultimately occur, inhibiting the growth of anything but plants specially adapted to withstand stagnant moist conditions.

Dehérain laid down the following rules by which can be predicted the influence of the subsoil on the soil.

(1) In a light soil with a permeable subsoil the results are entirely dependent on climate. If this be dry the soil may be extremely sterile. If the precipitation from the atmosphere be abundant or the soil be irrigated, tall vegetation will be supported.

(2) In a light soil with an impermeable subsoil the results are variable in a moderately moist climate according to the facility for natural drainage, the fertility depending on the slope. If the water can drain away, the land is fertile. When the soil is level the marshy conditions induced may render the soil useless.

(3) In a heavy soil with a permeable subsoil the excess of water readily drains away, and the land as a rule is fertile.

(4) In a heavy soil with a heavy subsoil marshy vegetation is produced, and the land must be drained before cultivation can succeed.

Broadly speaking, therefore, the more opposed are the characters of the soil and subsoil the more favourable it is to the plant grown on the soil. For example, heavy soils benefit by light subsoils and *vice versa*. Hard-pans, plough-soles, and other impermeable layers near the surface provide other instances of the great influence of subsoil on the soil. Extensive areas of flat land in parts of the Nelson and Westland Districts known as "pakihi" give one of the best examples of the effects of pan. (See this *Journal* for June, 1910, August, 1912, and September, 1913). It is true that cultivation, drainage, and liming will overcome to a great extent adverse subsoil conditions due to impermeability. Where there are both permeable soil and permeable subsoil the ill effects of excessive drainage, with its attendant droughtiness, may be modified by an exceedingly heavy and well-distributed rainfall or by green-manuring.

At Rotorua, however, we have a very interesting apparent exception to Dehérain's rule, where swampy conditions follow a soil originally permeable on a subsoil originally permeable—for here, owing to the watertable being so near the surface, marshy conditions result. This may be partly due to the quick growth of the lower aquatic

plants (algæ, &c.), bog mosses (sphagnum), the rise and fall of the Lake, and the banking-up of the copious rainfall. If pumice be kept moist enough for any length of time, under favourable conditions there results a slimy growth of lower plant-life, itself forming a non-permeable layer.

Each swamp or bog may have varying physical features operating to produce the result, but the fact remains that in the very large area of flat land of great potential value round Lake Rotorua, where both soil and subsoil strata were extremely porous, swamps are common, and usually must be drained before pasture can be successfully grown. The rise and fall of the Lake and the banking back of the heavy atmospheric precipitation has resulted in the production of grazing on coarse pumice saturated with water, and at favourable times yielding a highly nutritive fodder, although consisting mostly of weeds, Yorkshire fog, and sedges.

WEIGHT OF SOIL AS AN INDICATION OF POROSITY.

The weight of a given volume of soil is a valuable indication of the porosity of that soil. A number of weighings of $\frac{1}{8}$ cubic foot of soil were made in various localities of Rotorua district and the results calculated are as follows:—

	<i>West of Lake.</i>			Weight of Wet Soil per Cubic Foot.
Mamaku Demonstration Farm	..	..	..	75.47 lb.
Mamaku	..	..	..	70.30 lb.
Mamaku, Kaharoa clearing ..	..	..	..	70.30 lb.
Mamaku, Steele's old mill ..	..	..	..	69.30 lb.
Mamaku Demonstration Farm, unploughed ..	..	..	..	62.75 lb.
Oteroa	..	..	..	69.20 lb.
Oteroa, unploughed ..	..	..	..	78.30 lb.
Oteroa, ploughed	..	..	..	73.80 lb.
Oteroa, ploughed	..	..	..	75.40 lb.
Hamurana—				
Oteroa Road, ploughed ..	..	..	..	68.30 lb.
Hamurana Terrace, ploughed ..	..	..	..	77.80 lb.
Ngongotaha Lakeside ..	..	..	..	69.60 lb.
	<i>North of Lake.</i>			
Matai Road, unploughed ..	..	..	..	73.40 lb.
Matai Road, subsoil	..	..	..	81.70 lb.
Half-way House, Tauranga Road, ploughed ..	..	..	..	85.20 lb.
Kapakapa Road (sick), unploughed ..	..	..	..	75.10 lb.
Kapakapa Road (healthy), ploughed ..	..	..	..	85.20 lb.
Kapakapa Road (sick), unploughed ..	..	..	..	68.70 lb.
Kaharoa Road (end)	..	..	..	75.10 lb.
Kaharoa Road (entrance) ..	..	..	..	75.10 lb.
Paengaroa, ploughed	..	..	..	74.30 lb.
	<i>East of Lake.</i>			
Te Ngae (January), ploughed ..	..	..	..	98.60 lb.
Te Ngae (April), ploughed ..	..	..	..	83.30 lb.
Rotoiti (January), ploughed ..	..	..	..	77.80 lb.
Te Ngae, ploughed	..	..	..	98.50 lb.
Green Lake, unploughed ..	..	..	..	89.54 lb.
			(Dry weight, 66.46 lb.)	
Tikitere, ploughed	..	..	..	88.20 lb.
	<i>South of Lake.</i>			
Rainbow Mountain, unploughed ..	..	..	..	85.30 lb.
Whakarewarewa, unploughed ..	..	..	..	73.55 lb.
			(Dry weight, 50.30 lb.)	

Compared with the first 9 in. of English typical soils, the following particulars are of interest, the weights given being also per cubic foot:—

			Wet.	Dry.
Old pasture, Rothamsted (loam)	..	..	100.8 lb.	71.3 ll.
Arable land, Rothamsted	..	..	100.7 lb.	89.4 ll.
Arable land, Woburn (sandy soil)	..	..	117.4 lb.	96.6 ll.

It will be seen that all the soils from the areas on the western side of the Lake, particularly those at Mamaku and Kaharoa, are very light weight compared with the English soils cited, whereas those good "healthy" soils on the east side approach more nearly the English weights, except the Rotoiti soil, where the land is unhealthy for sheep only and may be therefore classed as slightly "sick."

This method of comparative weights is one which will be developed in the field, as it appears to offer an additional means of comparing soils of light texture.

THE SUBSOIL MAP.

Comparing the subsoil map of Rotorua County here presented* with the soil map published in this *Journal* for June, 1926, it will be seen that most of the sandy silt type of soil typical of a very large area from Mamaku to the edge of the Lake is superimposed on 9 in. of subsoil having the same texture. There is, however, a strip of coarser material, two or three miles wide and designated a coarse sandy silt, underlying the sandy silt soil and having its eastern margin almost conterminous with that of the Lake's western shore. This same subsoil underlies a large area of mixed types to the north of the Lake the soil of which is fine and coarse sandy silts and fine gravelly sands. To the north, north-east, and east of the Lake the subsoil is nearly wholly fine gravelly sand, but a very large area of fertile, undulating sheep and cattle country lying between Tarawera, Okataina, and Okareka Lakes is underlain by silt subsoil with a topsoil of calcareous loam. This is the most fertile area round Rotorua Lake, and it is puzzling to an agricultural chemist why all this type is not taken up and highly farmed.

* Northern part; the southern part will be published with the next article of the series.

NOTE.—In connection with the soil-survey work here dealt with, acknowledgments are made as follows: Samples collected by R. E. Grimmett; mechanical analyses made by F. J. A. Brogan; map plotted by F. T. Leighton. The weighings of volume weights were done by the writer.

(To be continued.)

Experimental Work on Export Fruit.—At the April meeting of the Research Council the Chairman reported on this subject: "Regular experimental shipments of fruit (apples and pears) have been forwarded by vessels leaving for the United Kingdom. The fruit has been collected by Mr. M. Davey, of the Department of Agriculture, from the Nelson and Hawke's Bay districts. Dr. Barnett has arranged for the placing of thermographs in the various consignments, and has had the co-operation of the Fruit Board and Harbour Board staffs. These shipments will be examined on arrival in Britain by the staff of the Low Temperature Research Station, Cambridge, and, judging by the report on last year's fruit shipments, very valuable information should be forthcoming."

TEMPORARY STERILITY OF DAIRY COWS.

PRACTICAL POINTS FOR FARMERS.

Live-stock Division.

THE condition generally known as temporary sterility of dairy cows is a cause of considerable loss and trouble to farmers in New Zealand and in all other dairying countries. In females of all types of animals, including cattle, there are always some who, through individual idiosyncrasy, will not breed regularly or not breed at all. This temporary form occurs so frequently that it raises a perplexing problem. Cows exhibiting it will almost invariably get in calf at times varying usually from two to four months from the time of the first unsuccessful service; hence there can be no permanent defect in the generative organs of the animals, though there is evidently some cause or causes operating which prevent conception taking place at the time of the first or second service.

Intensive research aimed at determining how the trouble comes about and how it can best be combated is in progress in this country, in America, Britain, Denmark, and other countries on the Continent of Europe. Meanwhile, all the knowledge we have available must be applied to the problem of reducing the number of cases of temporary sterility to as low a proportion as possible.

Management and Treatment of the Bull.

In examining the position the degree to which the bull may be responsible for cows failing to hold must be fully considered, and there is good reason for believing that the adoption of the best methods of management of the bull will be of definite value. Points in such management are as follows:—

(1) Never let the bull run with the herd, but keep him apart in an enclosure where adequate shelter is provided. Take each cow to him for service only when she is ready. Let her have two services, and then take her back to the paddock. This enables the bull to conserve his energy, instead of wasting it in unnecessary services and perhaps (especially in the case of a very young bull) rendering himself temporarily useless from time to time.

(2) Do not allow the bull to be too fat and "soft" when the time for service arrives. He needs to be in really good condition, but this can be overdone at the expense of the sustained energy and vitality necessary for the effective carrying-out of his season's work.

(3) If a bull aged eighteen months or thereabouts is used, do not overwork him by giving him too many cows to serve.

(4) Examine the bull's organ carefully before the season commences, in order to be satisfied that it is perfectly clean and healthy. Also examine it at frequent intervals afterwards. If it is not healthy, treatment must be applied at once. The form of treatment depends on the nature of the trouble affecting it, and, wherever possible, the advice of a Veterinarian or Stock Inspector should be sought. If this is not immediately available it is a good practice meanwhile to syringe into

the sheath twice daily a mild solution of ordinary table salt. This should be prepared as follows: Boil 1 quart of water to sterilize it, and add $\frac{1}{4}$ oz. salt. Allow the fluid to cool to blood-heat, and then inject it gently into the sheath, the opening of the sheath being at the same time held as closely as possible round the injection tube so that the fluid does not escape too quickly. Skilled advice should be obtained on the spot as soon as possible, so that, if necessary, more specialized treatment, according to the exact nature of the affection, may be applied. But the salt solution is a good standby for the farmer until he can secure this advice.

(5) A bull with any diseased condition of his penis should never be allowed contact with any cow.

Management and Treatment of the Cow.

The modern dairy cow, especially if milking heavily over a full season, is subjected to a steady call upon her system which is far in excess of what would be the case were she living and rearing her calf under natural conditions. There is an intimate association between the functions of milk-production and the functions of procreation. Hence it is not difficult to realize that the dairy cow is liable to fail to respond always in a natural way to the requirements of the farmer as to getting in calf quickly, after she has concluded a season's hard work in milk-production and has commenced another. It is necessary, however, in the interests of the dairy industry to do all that is necessary in the light of our present knowledge to get cows to hold at the time required, and the following points should therefore be carefully observed:—

(1) Examine the passage of each cow as carefully as circumstances permit, in order to determine whether there is any indication of an inflammatory condition or whether any discharge is present. If either is the case, do not put the cow to the bull until the trouble has ceased, and if possible get skilled advice on the spot regarding the treatment necessary to bring about recovery. Pending this, the passage should be gently washed out once or twice daily either with the salt solution recommended for the treatment of the bull or with a very weak solution of permanganate of potash. A cow with any discharge from the passage should be isolated from the rest of the herd until the discharge has completely ceased. This is an important matter of general sanitary precaution. Vaginitis (an inflamed condition of the membranes of the vagina) is a disease frequently met with in this country, and has often been regarded as the chief cause of cows failing to hold to the bull. While such a conclusion, more especially in acute cases, cannot be ruled out, our investigations have failed to show that this is always the case, and it would appear that vaginitis is only a minor factor in temporary sterility.

(2) At the time when it is desired to put cows to the bull, graze them on paddocks where the feed is fresh and sweet, and free from rankness or roughage. This will assist in maintaining normal conditions of bodily health, and prevent digestive disturbances which may react on the nervous system, and through it upon the generative system.

(3) Any cow that has aborted or has retained the cleansing longer than is normal, or has shown a discharge from the vagina for a time

after calving and cleansing, should be at the time washed out once or twice daily with a mild antiseptic solution until the discharge ceases. The other parts also should be washed with the same solution. In addition to this, she should be washed out with the salt solution already described once daily for a week before she is expected to be ready to go to the bull. It is also a good practice to give such a cow—or, for that matter, all cows in good health and condition—two doses of laxative medicine at intervals of four days before service. Epsom salts, 12 oz. dissolved in $1\frac{1}{2}$ pints of warm water or thin gruel, will answer this purpose admirably.

(4) When a cow fails to hold to her first service two courses are open to the farmer. One is to allow her to miss the next period of heat, and try her again when the following period occurs. This often results successfully. The other course is to try her again at the next period, and if this is adopted it will certainly be advisable to give her a dose of laxative medicine two or three days before service, as advised in paragraph (3). Care should be taken to graze her on the best and cleanest pasture available. The practice of washing out the vaginal passage is largely adopted, and, provided mild and suitable liquid solutions are used, no harm is likely to result, and some good may be done in individual cases. The salt solution already mentioned is safe and useful, and the same applies to a very weak solution of potassium permanganate. 

General.

On account of the trouble experienced it has become quite a common practice to let a cow miss a complete season when she has failed to hold to her first service. When this is done she almost invariably holds when she is later put to the bull. This, however, means a loss, and what is desired is to get as many cows as possible in calf at the proper time. Hence farmers are advised to adopt, as fully as they can, the methods which have been described here.

It may be added that, apart from the exact and extensive research which is being carried out, the Department of Agriculture has been conducting this season a number of experiments with foods, soil treatment, and special forms of medicinal treatment. The results of these experiments will be made known when the work is completed.

POISONING OF SMALL BIRDS WITH STRYCHNINED WHEAT.

THE following recipe and directions for the poisoning of small birds (when circumstances compel such a course) are contributed by Mr. J. C. Neill, of the Plant Research Station, Palmerston North, who vouches for the efficacy of the method:—

Recipe: (1) Mix two tablespoonfuls of sugar with two tablespoonfuls of water; (2) thoroughly mix this syrup with 12 lb. of wheat; (3) sprinkle 2 oz. of strychnine over the wheat while stirring vigorously. (Larger or smaller amounts in corresponding proportions.) Procedure: Scatter unpoisoned wheat over the ground for two or three days at about the same hour each day; then, at the same hour on the following day, scatter the poisoned wheat.

MINERAL CONTENTS OF SOME TYPICAL PASTURES IN WAIMEA COUNTY.

T. RIGG and H. O. ASKEW, Division of Agriculture, Cawthron Institute, Nelson.

Introduction.

THE work of J. B. Orr and his colleagues at the Rowett Institute has directed attention to the great importance of the mineral constituents in grass pasture in maintaining health and in producing optimum results from grazing-animals. These workers have shown that a deficiency of one or more minerals may be responsible for high mortality in stock, and that a lack of balance in the proportions of the mineral constituents of pasture frequently accounts for the inferior results in the fattening-qualities of particular pastures.

Much work on somewhat similar lines has been done in South Africa, where great deficiency of phosphate has been shown to be the initial cause of heavy losses in stock grazing on the veld.

In New Zealand B. C. Aston and his co-workers have shown that a deficiency of iron is the cause of "bush sickness" in the Rotorua district⁽¹⁾, and that a deficiency of lime in the Mairoa pastures is responsible for the poor results which have been obtained by many farmers in the latter district in recent years⁽²⁾. More recently a deficiency of phosphate in both pasture and soil has been shown to be associated with "Waihi disease," and with unsatisfactory results from dairy cows on certain Wairarapa pastures⁽³⁾.

Owing to soil-erosion, and the continual loss of minerals from the soil by the leaching-action of rain and by the grazing of stock, a great reduction in the mineral supply of the soil must have taken place over large areas of New Zealand pastures during the last forty years. It is true that lime and phosphate are now being used more extensively for top-dressing, but millions of acres of less accessible pasture-land have not so far received any treatment. It is well known that a great deterioration in many hill pastures has occurred during the last twenty years. This has not only resulted in a greatly reduced carrying-capacity of such pastures, but the health of the stock also has frequently suffered and farmers fail to obtain the returns per head of stock which they formerly secured when the land had a higher carrying-capacity.

The results obtained by B. C. Aston in connection with the Mairoa and Wairarapa pastures point clearly to the existence of mineral deficiency on a widespread scale throughout New Zealand. Many pastures which at the present time are not associated with loss in stock must be near the borderline of mineral deficiency, and, within the next ten years, unless steps are taken to supply the deficient minerals, will probably give as poor results to their owners as the deficient pastures in the Mairoa and Wairarapa districts.

⁽¹⁾ Trans. N.Z. Inst., vol. 55, 1924, p. 720-23.

⁽²⁾ Trans. N.Z. Inst., vol. 59, 1928, p. 406.

⁽³⁾ Trans. N.Z. Inst., vol. 59, 1928, p. 650.

The facts which have been elicited by Aston and his co-workers point clearly to a close connection between soil properties and the mineral supply of the pastures. The data which have been obtained both on soil and pasture grass should prove valuable as standards for comparison in diagnosing deficiencies in other pastures.

With a view to the collection of additional data concerning the mineral status of New Zealand pastures, a systematic examination of the mineral constituents in the pastures of Waimea County, Nelson, was undertaken by the Cawthron Institute. Owing to the varied geology of the Nelson District great variation in soil-properties occurs within a limited area, and it was anticipated that a corresponding variation in the mineral constituents of the pastures would be revealed. Furthermore, high mortality in stock and unsatisfactory results from stock were known to occur in several localities, and it was thought that the analyses of pasture-samples would point clearly to the causes for both good and poor results secured by farmers.

It was hoped that the analytical data thus accumulated would be not only valuable to the Nelson District in suggesting methods for the improvement of pastures, but would also serve as standards of comparison for other pastures in New Zealand located on similar soil-types under somewhat similar climatic conditions.

COLLECTION OF SAMPLES.

The soil map of Waimea County prepared by Messrs. T. Rigg and J. A. Bruce was used as a basis in the selection of pastures typical of various soil-types in the county. In sampling the pastures care was taken to secure only green growth, so that a comparison could be made of the mineral status of the pasture at the same stage of growth development in each case. A series of samples representative of the pastures associated with the more important soil-types was collected during April after the autumn rains had brought the grass away. The autumn and summer of 1928 were very dry, and on the hill pastures practically no growth was made until after heavy rains at the beginning of April. In a number of instances samples of hill pastures were collected from areas which had been burnt over during the summer. This made the work of collecting green growth uncontaminated with mature grass comparatively easy, but on the other hand the analyses of the grass so collected probably represent the optimum mineral content of these pastures.

Although it has not been possible to complete the analyses of all the samples, sufficient have been finished to demonstrate the nature of the variations in the mineral supply of typical pastures representative of some of the more important soil-types.

1. Hill Pastures of Waimea County.

Samples of pasture were collected during April, 1928, from six soil-types which had widely different soil characteristics. No treatment had been given the pastures, as far as could be ascertained, since their establishment decades ago. The mineral composition of the pastures should therefore reflect the natural supply of minerals in these soils of different derivation.

The soil-types chosen for the study of their associated pastures have been named in the soil classification adopted by the Cawthron Institute as follows: (1) Moutere Hills type, (2) Wakapuaka type, (3) Heslington type, (4) Orinoco type, (5) Kaiteriteri type, (6) Pikikiruna type.

In every case the name which has been given the soil-type indicates the locality where extensive areas of the soil are found.

GEOLOGICAL ORIGIN OF THE SOILS.

The Moutere Hills soil has been derived from the weathering of a vast deposit of gravels laid down in Pleistocene times. The gravels consist mainly of sandstone, claystone, and greywacke very much weathered and decomposed. The principal soil is a loam underlaid by a sandy clay. It has excellent textural qualities and is well suited to the growth of trees. Pastures on this soil-type are very poor, and frequently run less than half-sheep per acre.

The Wakapuaka soil-type is derived from the weathering of basic igneous rocks which are described by Hochstetter⁽⁴⁾ under the name "augite-porphry." Bell and others state that the rocks consist mainly of small grains of augite, together with feldspar and serpentine⁽⁴⁾. They state that they are altered olivine basalt, and use the term "melaphyre" for them. The soils derived from these rocks are loams which possess some variation in texture on different parts of the soil-type. The pastures associated with these soils are considered excellent for stock purposes and maintain at least two sheep per acre.

The Heslington soil-type is derived from the weathering of Triassic shales. The soil is a light loam, which is highly favoured by farmers for early pea and market-garden culture. When in pasture excellent results are obtained from sheep. The carrying-capacity is about one and a half sheep per acre.

The Orinoco soil-type is derived from the weathering of hornblende schists and porphyries⁽⁵⁾. The soils are usually sandy loams. The pastures associated with these soils maintain about one and a half sheep per acre, and are considered very satisfactory by stockmen.

The Kaiteriteri soil-type is derived from the weathering of granite and quartzites. There is a considerable variation in texture on different parts of the soil-type. Very poor pastures and indifferent results with stock are associated with this soil-type. The carrying-capacity is approximately half-sheep per acre.

The Pikikiruna soil-type is derived from the weathering of crystalline limestones which come to the surface on many parts of the soil-type. Excellent results with stock are obtained on this soil-type, the carrying-capacity being about one and a half sheep per acre.

CHEMICAL CHARACTERISTICS OF THE SOILS.

In Table I some chemical criteria in connection with the soils are set out. It will be seen that the Moutere Hills and the Kaiteriteri soil-types are outstandingly poor soils. The supply of organic matter,

⁽⁴⁾ The Geology of the Dun Mountain Subdivision. Bull. No. 12 (New Series), N.Z. Geol. Survey. By James M. Bell, E. Clarke, and P. Marshall.

⁽⁵⁾ S. H. Cox: Geology of the Riwaka Range. N.Z. Geol. Reports, 1879-80.

Table 1.—Sundry Chemical Characteristics of the Soils.

	Moutere Hills.	Wakapu-aka.	Hesling-ton.	Orinoco.	Kaiteri-teri.	Pikikiruna.
Loss on ignition ..	6.10	10.90	9.50	17.10	7.05	11.90
Total nitrogen ..	0.10	0.26	0.24	0.42	0.10	0.40
Soluble in 1 per cent. citric acid—						
Available phosphoric acid, P_2O_5	0.003	0.004	0.029	0.067	0.003	0.018
Available potash, K_2O	0.007	0.017	0.037	0.015	0.009	0.029
Lime-requirement figure	0.32	0.15	0.13	0.40	0.27	0.16

NOTES.—With the exception of the Pikikiruna soil, a number of samples representative of each type have been analysed. The figures quoted above are the averages for each set of samples.

All data from Table 1 are adopted from unpublished records of the soil survey of Waimea County.

nitrogen, and phosphate are all low. Both soils are markedly acid in reaction, and little improvement in crop-production is obtained without the use of both lime and phosphate. The Wakapuaka soil-type is also low in available phosphate, but the amount extracted with hydrochloric acid from this soil is almost normal—0.09 per cent. P_2O_5 , against 0.025 per cent. P_2O_5 in the Moutere Hills type. The Orinoco soil-type is outstandingly high in phosphoric acid. It has a marked acid reaction, but it probably has a fair supply of easily replaceable lime. The Pikikiruna and Heslington types are well supplied with phosphate, and together with the Wakapuaka type have comparatively low lime-requirement figures.

NOTES ON THE BOTANICAL COMPOSITION OF THE PASTURES.

The dominant species of the Moutere Hills and Kaiteriteri pastures are *Agrostis* sp. and danthonia. Clovers, and indeed leguminous plants, are present in exceedingly small proportions in the pastures sampled. The dominant species of the Heslington pasture is danthonia, with some perennial rye-grass, fescue, trefoil, and agrostis.

In the case of the Orinoco pastures the more important species are danthonia, trefoil, and white clover, with some fescue, yarrow, and agrostis.

The Wakapuaka pasture-samples consist mainly of perennial rye-grass, *Poa pratensis*, fescue, and some white clover. White clover is an important constituent of this pasture, but owing to its short growth at the time of sampling little was included in the samples analysed.

The Pikikiruna pasture-sample consists mainly of danthonia, perennial rye-grass, white clover, and trefoil.

ANALYSIS OF THE HILL PASTURES.

The analytical data in connection with the pastures given in Table 2 represent the average for two or more samples from each soil.

The poor qualities of the Moutere Hills and Kaiteriteri soil-types are reflected in the mineral composition of the pastures associated

with them. The low content of soluble ash, phosphate, and nitrogen are characteristic features of the analyses of these pasture-samples. Both pasture-types contain a low percentage of iron and a high percentage of manganese. A somewhat similar relationship between iron and manganese has been noted by Grimmett and Simpson⁽⁶⁾ in the case of the "pinning" pastures of Scotland. The percentage of lime in the Moutere Hills and Kaiteriteri pastures is very low, but the pastures on some of the better soil-types have also a comparatively low percentage of lime.

Table 2.—Analyses of General Pasture Samples from Hill Soil-types.

		Moutere Hills (Pleistocene Gravels).	Wakapu- aka* (Basic Igneous Rocks).	Hesling- ton (Triassic Shales).	Orinoco (Horn- blende Gneiss).	Kaiteri- teri (Granite).	Piki- kiruna (Lime- stone).	English Hill Pastures† (partly grazed).
Lime	CaO	0.61	0.54	0.64	0.82	0.56	0.98	0.56
Phosphoric acid	P ₂ O ₅	0.63	0.85	0.95	0.94	0.64	0.95	0.60
Potash	K ₂ O	3.19	4.21	3.63	4.44	2.93	4.02	2.60
Sodium oxide	Na ₂ O	0.12	0.21	0.26	0.12	0.19	0.26	0.41
Chlorine	Cl	1.07	1.64	1.18	1.54	1.00	1.03	0.60
Nitrogen	N	3.43	5.08	5.00	4.92	3.32	5.02	2.54
Sulphur	S	0.33	0.33	0.33	0.35	0.24	0.35	..
Iron	Fe	0.011	0.043	0.025	0.045	0.016	0.016	..
Manganese	Mn	0.052	0.022	0.018	0.038	0.042	0.018	..
Total ash	..	11.67	11.31	11.15	12.07	10.63	11.11	7.46
Soluble ash	..	6.15	8.17	7.33	8.70	5.99	8.25	5.49
Insoluble ash	..	5.52	3.14	3.82	3.37	4.64	2.86	1.97

* White clover is an important constituent of this pasture. Owing to the short growth little clover was included in the samples collected for analysis. The lime content is therefore considerably lower than might have been expected.

† W. B. Godden. Jour. Agric. Sci., 1926, vol. 16, pt. 1, p. 81.

NOTES.—All determinations are expressed as percentages of dry matter.

All Nelson samples represent young green growth collected in autumn, 1928.

The Pikikiruna and Orinoco samples contain exceptionally high percentages of lime and phosphate for untreated hill-pastures. The percentages of soluble ash and nitrogen in these pastures compare favourably with those of top-dressed pastures on the alluvial flats. One sample from the Pikikiruna soil-type contained only 0.010 per cent. of iron. This approaches closely the percentage of iron found by Aston⁽⁷⁾ on pastures affected with "bush sickness." Symptoms of "bush sickness," however, have not been observed on the Pikikiruna pastures, which are noted for their excellent qualities.

The Heslington and Wakapuaka pastures fall into an intermediate group. They both have a high content of soluble ash, nitrogen, and phosphate, but the percentage of lime is low. This can be partly explained by the small amount of leguminous plants contained in the samples analysed. In the case of the Wakapuaka sample the lime content as revealed by the analyses is probably considerably below the average lime-content of this pasture for the whole season. Both pasture-types are well supplied with iron, and there is a normal ratio between iron and manganese.

⁽⁶⁾ N.Z. Inst. Trans., vol. 59, 1928, p. 401.

⁽⁷⁾ N.Z. Jour. Agric., vol. 36, No. 2, p. 80.

In comparison with the average mineral content of partly grazed hill-pastures in Great Britain⁽⁸⁾, there is a fairly close resemblance in the case of the Moutere Hills and Kaiteriteri pastures. The other types have much higher figures for their mineral constituents. The nitrogen and chlorine contents of the Nelson pastures are much higher than in the hill pastures examined by Godden. There does not appear to be as close a correlation between the chemical criteria of the soils and the mineral contents of the pastures as might have been expected. The soil-types abnormally low in phosphate are associated with pastures containing low amounts of phosphate, but when the amount of phosphate in the soil rises above a certain figure comparatively little difference is shown in the phosphate content of the pastures. The lime-requirement figure as a measure of lime deficiency in the pasture is not very satisfactory. It is probable that a much closer correlation exists between replaceable bases in the soil and the mineral supply of the pastures. The chemical criteria of the soil-types show more relationship between a wider flora range and carrying-capacity per acre than with the actual mineral content of the pastures.

2. Pastures of the Alluvial Flats.

Owing to the varied geology of the Nelson District there is great variation in the parent material from which different alluvial soils have been derived. Some of the alluvial soils are extraordinarily fertile, and in cases show little drop in production even after forty years of continuous grazing by stock, while others are noted for their infertility and their poor pastures. The analyses of pasture-samples from the alluvial soils are shown in Tables 3 and 4.

In the case of the pastures included in Table 3, stockmen speak highly of them, and in many cases they are noted for their milk-producing or fattening qualities. Sample No. 1 is from the dairying pastures of Richmond, and with the exception of a little oats, hay, and roots fed on the field the land has had no manurial treatment for many years. It is located on a stony loam well supplied with organic matter and containing a moderate supply of available plant-food. For the last seven years it has been shut up for hay and grazed during the rest of the year. The pasture has a mixed flora of perennial rye-grass, timothy, cocksfoot, fog, sweet vernal, trefoil, and clover. Despite the fact that artificial fertilizers have not been used the mineral content of the pasture remains at a high level.

Sample No. 7 was collected from the highly fertile Riwaka loam, which is noted for its excellent textural qualities and its high content of plant-food. Samples of soil from this type frequently contain 0.1 per cent. available phosphoric acid. The dominant species in the pasture are perennial rye-grass and white clover. The phosphoric-acid content of this pasture is amazingly high when compared with the average content of typical cultivated English pastures analysed by Godden⁽⁸⁾. On the assumption that such a pasture produces during the growing-season 3 tons per acre of dry grass in the young-growth

(8) Jour. Agric. Sci., 1926, vol. 16, pt. 1, p. 81.

Table 3.—Analyses of Pasture Samples from Different Soil-types giving Good Results with Stock.

			Laboratory No.								Average for Eight Samples.	Average English Cultivated Pastures.*
			1.	7.	8.	13.	18.	25.	27.	59.		
Lime	CaO	..	0.74	0.96	0.66	1.10	0.61	0.66	0.82	1.07	0.83	1.00
Phosphoric acid	P ₂ O ₅	..	0.90	1.29	0.96	1.04	0.94	1.08	1.09	1.18	1.06	0.74
Potash	K ₂ O	..	3.79	3.47	3.92	4.42	3.30	3.94	4.54	4.34	3.96	3.18
Sodium oxide	Na ₂ O	..	0.58	0.65	0.31	0.36	0.69	0.46	0.35	0.52	0.49	0.25
Chlorine	Cl	..	1.21	1.36	1.17	1.62	1.51	1.61	1.61	1.51	1.45	0.95
Nitrogen	N	..	5.39	5.10	4.79	5.75	5.49	5.04	5.54	5.66	5.34	2.83
Sulphur	S	..	0.47	0.32	0.36	0.39	0.54	0.48	0.44	0.44	0.43	..
Iron	Fe	..	..	0.014	0.053	0.020	0.032	0.013	0.040	0.059	0.033	..
Manganese	Mn	..	..	0.016	0.021	0.040	0.008	0.012	0.014	0.008	0.017	..
Total ash	..	..	10.91	10.83	11.36	13.21	11.69	10.45	12.34	12.71	11.69	9.79
Soluble ash	..	..	8.71	8.71	8.27	10.10	8.90	9.09	9.27	9.72	9.10	6.64
Insoluble ash	..	..	2.20	2.12	3.09	3.11	2.79	1.36	3.07	2.99	2.59	3.15

* Analyses by W. Godden. Jour. Agric. Sci., 1926, vol. 16, pt. 1, p. 81.

NOTE.—All Nelson determinations made on green autumn growth and expressed as percentages of dry matter.

stage, no less a quantity than approximately 4 cwt. equivalent of superphosphate per acre is taken up by the grasses and clovers.

Sample No. 8 is taken from an untreated pasture which has been down many years. The pasture is located on a very fertile sandy loam at Umukuri. The soil has a very high content of available phosphoric acid, but has a markedly acid reaction. The main constituents of the pasture are perennial rye-grass and white clover.

Sample No. 13 is taken from a more recently established pasture on a soil made by the re-sorting of the Moutere Hill detritus. Liming at the rate of 2 tons of ground limestone per acre and regular phosphatic manuring have been the secret of success in establishing a first-class pasture on a comparatively poor soil. The dominant constituents of the pasture are perennial rye-grass and white clover. The influence of heavy liming is clearly seen in the high lime content of the sample analysed. Formerly the owner had difficulty in fattening lambs and secured only a 40-per-cent. increase in his flock. Since the establishment of good pasture, using lime and phosphate, he has averaged 90 per cent. of lambs. Lambs running with their mothers on this pasture have attained a dressed weight of 68 lb. in less than five months.

Sample No. 27 was collected from a pasture which has been established for four years. The pasture is located on better-quality Moutere Hills soil. Two tons of ground limestone per acre and a liberal application of phosphate were used in the establishment of the pasture. The pasture has been regularly top-dressed with superphosphate. The pasture contains perennial rye-grass, white clover, and cocksfoot as the dominant species. Formerly the land carried indifferently less than one sheep per acre, but since the establishment of the good pasture four sheep per acre have been maintained, with great improvement in the condition of the stock.

Sample No. 18 was collected from a top-dressed pasture on a heavy loam. At the time of establishment four years ago 1 ton of ground limestone per acre was applied to the land. The pasture is regularly top-dressed with 2 cwt. superphosphate per acre. Perennial rye-grass, cocksfoot, and white clover are the principal constituents of the pasture. Excellent results with dairy cows are obtained by the owner.

Sample No. 25 was taken from the peat lands at Wakapuaka. The pasture is excellent for fattening stock. No treatment has been given for many years. The main constituents of the pasture are perennial rye-grass and white clover.

Sample No. 59 was collected from an excellent pasture of rye-grass and white clover situated on the alluvial flats formed by the Wakapuaka River. As far as could be ascertained no treatment has ever been applied to this pasture. Both sheep and cattle do well on it, and many fat stock are sent to the market. The soil is a light loam well supplied with organic matter, is neutral in reaction, and has no lime-requirement. It is moderately well supplied with available plant-food.

The outstanding features of the analytical data in connection with the good pastures enumerated in Table 3 are the high percentages of soluble ash and phosphoric acid. The lime content with but one exception falls considerably below the average figure given by Godden⁽⁸⁾ for English cultivated pastures.

The nitrogen content of all the samples is exceedingly high. Some samples contain double the amount quoted by Godden. Woodman has remarked on the high proteid value of green grass in his experiments in England, but the average content of crude proteid in the good Nelson pastures is considerably higher. Woodman⁽⁹⁾ found 27.92 per cent. crude proteid in the autumn cuts of a good pasture on a sandy soil. The average for crude proteid in the case of the eight samples quoted in Table 3 is 33.37 per cent. Sample No. 13, indeed, attains the remarkable figure of 35.94 per cent. crude proteid.

The analyses reveal the fact that a considerable variation in the percentages of iron and manganese may occur in the pastures without any obvious detrimental effects on stock. It must, however, be remarked that no instance occurs of an extremely low content of iron associated with a high content of manganese. The influence of liming and phosphatic manuring on the mineral contents of pasture can be readily seen in the case of a number of the analyses shown in Table 3.

Some abnormal pastures on certain alluvial soils are dealt with in Sections 3 and 4.

3. Pastures giving Poor or Indifferent Results with Stock.

The chemical data for pastures from a number of different soil-types giving unsatisfactory results with stock are tabulated in Table 4.

(a) The Moutere Hills and the Kaiteriteri pasture-types have already been discussed in Section 1. Both sets of grass-samples are low in lime, phosphoric acid, soluble ash, and nitrogen. They have a low content of iron and an abnormal iron-manganese ratio. The occurrence

⁽⁹⁾ Jour. Agric. Sci., 1926, vol. 16, p. 228.

Table 4.—Analyses of Pasture Samples from Different Soil-types giving Poor or Indifferent Results with Stock.

			Moutere Hills.	Tahuna Fine Sand.	Kaiteriteri.	Gordon Fine Sands.	Wakapu-aka Silt.	Average for Good Pasture (Nelson).
Lime	CaO	..	0.61	0.49	0.56	0.23	0.36	0.83
Phosphoric acid	P ₂ O ₅	..	0.63	0.68	0.64	0.82	1.04	1.06
Potash	K ₂ O	..	3.19	3.38	2.93	2.80	3.33	3.96
Sodium oxide	Na ₂ O	..	0.12	0.13	0.19	0.12	1.41	0.49
Chlorine	Cl	..	1.07	1.17	1.00	0.77	2.91	1.45
Nitrogen	N	..	3.43	3.75	3.32	3.93	4.39	5.34
Sulphur	S	..	0.33	0.32	0.24	0.26	0.54	0.43
Iron	Fe	..	0.011	0.013	0.016	0.043	0.011	0.033
Manganese	Mn	..	0.052	0.035	0.042	0.004	0.007	0.017
Magnesia	MgO	..	..	..	..	0.96	..	0.70*
Total ash	..	..	11.67	10.87	10.63	12.69	11.69	11.69
Soluble ash	..	..	6.15	6.71	5.99	6.06	9.86	9.10
Insoluble ash	..	..	5.52	4.16	4.64	6.63	1.83	2.59

* One sample only.

NOTE.—All determinations made on autumn green growth and expressed as percentages of dry matter.

of xanthin calculi in the kidneys of sheep pastured on the Moutere Hills type will be dealt with in another paper. It is probable that xanthin calculi occur in sheep pastured on the Kaiteriteri type, but so far no case has come under our personal observation. Both pasture-types are associated in certain seasons with high mortality of sheep, particularly of hoggets.

The pastures of the Tahuna sands give unsatisfactory results with stock unless lime and phosphate treatment has been given. Sheep fail to maintain their condition, and "pica" in stock is common. Where tree-lucerne is grown it is stripped bare of foliage and bark by stock. The main constituents of the flora are *Agrostis* sp. and danthonia, with a little trefoil and fog. The chemical analysis of untreated pasture shows that it has a low feeding-value. The mineral supply is low, particularly in lime and phosphate.

(b) The pastures associated with the Gordon fine sands in a part of the Motueka Valley provide very little growth at any time of the year. But even with light stocking, stock waste rapidly away if kept too long on them.

The Gordon fine sands are derived mainly from the detritus brought down by the Motueka River from serpentinous rocks in Mineral Belt country. The soil is neutral in reaction and has no lime requirement. It is also deficient in available phosphoric acid.

The chemical data for these pastures are of great interest in view of the low fertility of the soils and the poor results with stock. The outstanding feature of the analyses is the extremely low percentage of lime. The samples are relatively high in magnesia and silica. The percentage of iron is also high, but that of manganese is correspondingly low. The results of the analyses suggest that a great deficiency of lime is the principal factor responsible for poor stock conditions.

(c) In the case of the pasture associated with the Wakapuaka silt loam, which has been reclaimed from the sea during the last twenty years, no definite facts concerning behaviour of stock on the pasture could be secured, as the animals have access to good pasture. Owing to the abnormal features revealed by the analysis it has been included in Table 4 for consideration.

The main constituents of this pasture are perennial rye-grass, trefoil, and white clover. Owing to the short growth of trefoil and white clover the sample analysed consists mainly of perennial rye-grass. The most important features of the analytical data for this pasture are the high percentages of chlorine and sodium, and the abnormally low content of both lime and iron.

4. Suspected "Bush-sick" Pastures.

Certain pastures located on granite soils in the vicinity of the Hope and Sherry Rivers are of exceptional interest. Serious losses of stock have occurred when the grazing has been restricted to some parts of the farms. The stock on such areas within a short time exhibit typical symptoms of "bush sickness." It seems probable that a very considerable tract of country is affected—possibly embracing a great part of the Kaiteriteri soil-type. Owing, however, to the narrow outcrop of the Kaiteriteri granite in other parts of the country, and to the extensive nature of the grazings, typical "bush sickness" in other parts of the district has not been reported.

Certain pastures in the vicinity of Glenhope where typical symptoms of "bush sickness" occur have been closely studied with a view to the elucidation of the problem. Owners of property in this locality state that symptoms are apparent within three weeks if sheep are grazed exclusively on affected pastures. Death of the animals frequently ensues within six to nine months from the commencement of grazing.

COLLECTION OF SAMPLES.

A number of samples from both healthy and affected pastures were collected during the autumn and spring. These samples, together with the chemical analyses, are recorded in Table 5. Samples Nos. 39 and 128 were collected from a typical hill pasture affected with "bush sickness." Nos. 40 and 129 were taken from an untreated field on the alluvial flats formed by the Hope River. These flats consist largely of detritus derived from granite country lying between Glenhope and the Sherry Valley. They are known to be affected with "bush sickness." Sample No. 40 was collected from a field on the alluvial flats which had been top-dressed in 1918 with 2 tons of ground limestone per acre. The owner of the property states that lime and phosphate treatment of the pasture accentuated the incidence of "bush sickness" in stock. Sample No. 130 was collected from a very swampy field on the alluvial flats. "Bush sickness" is said to be particularly bad on this field. Samples Nos. 131 and 132 were collected from healthy country in the vicinity of Glenhope. Sample No. 131 came from another type of granite country which has a high carrying-capacity and which gives excellent results with stock. Sample No. 132 came from the less fertile Moutere Hills country, which, however, is not associated with "bush sickness."

Table 5.—Analyses of Pasture Samples from "Bush-sick" Area, Glenhope.

		Autumn Samples.			Spring Samples.			Adjoining Healthy Country (Spring Samples).	
		No. 40.	No. 41.	No. 39.*	No. 128.	No. 129.	No. 130.	No. 131.	No. 132.
Lime	CaO ..	0.56	0.75	0.55	0.47	..	..	..	..
Phosphoric acid	P ₂ O ₅ ..	0.71	0.94	0.47	0.70	..	..	..	..
Potash	K ₂ O ..	..	..	1.85	3.21	..	..	..	..
Sodium oxide	Na ₂ O ..	..	..	0.16	0.09	..	..	..	..
Chlorine	Cl ..	..	..	0.48	0.76	..	..	..	..
Nitrogen	N ..	..	..	1.90	3.29	..	..	..	..
Sulphur	S ..	..	..	0.14	0.31	..	..	..	..
Iron	Fe ..	0.017	0.014	0.008	0.014	0.014	0.011	0.040	0.040
Manganese	Mn ..	0.042	0.028	0.029	0.020	0.025	0.034	0.012	0.027
Total ash		..	..	8.17	8.57	..	..	..	..
Soluble ash		..	..	4.04	5.77	..	..	..	..
Insoluble ash		..	..	4.13	2.80	..	..	..	..

* This sample contained some more mature grass.

NOTE.—All determinations made on green growth and expressed as percentages of dry matter.

BOTANICAL NOTES ON THE PASTURE-SAMPLES.

In the case of the granite hill pasture—Samples Nos. 39 and 128—the dominant species is Chewings fescue. There is a good sole of grass, and plenty of feed is available. The soil has a loose porous texture, but there is a plentiful supply of moisture during most times of the year.

Samples Nos. 49 and 129 contain fescue, *Agrostis* sp., fog, and danthonia. Sample No. 41 consists mainly of white clover, cocksfoot, and danthonia. Sample No. 130 consists mainly of fog and *Agrostis* sp. Sample No. 131 contains fescue, white clover, *Lotus* sp., and cocksfoot. Sample No. 132 contains danthonia, fescue, *Agrostis* sp., and a little fog, *Lotus* sp., and white clover. With the exception of No. 39, which contains some more mature grass, all the samples consist of young green growth.

THE ANALYTICAL DATA.

The most significant feature of the analyses is the low content of iron associated with all the pasture samples collected from "bush sick" country. The low content of iron is a marked feature of both spring and autumn samples. Pasture-samples from other soil-types in the Waimea County have been characterized by a low content of iron in the autumn samples, but the spring samples have all shown greatly increased percentages⁽¹⁰⁾. Samples Nos. 131 and 132, from healthy country in the vicinity, contain nearly three times the percentage of iron found in the "bush sick" pastures. It is interesting to note that the iron content of the spring samples from reputedly "bush sick" pastures was little affected by varying moisture conditions of the soil.

With the exception of the pasture which has had lime treatment, all the samples from "bush sick" country have a low lime content. This is particularly marked in the spring sample No. 128 from the hill

⁽¹⁰⁾ Unpublished data concerning seasonal variation in the mineral contents of pasture.

country. The occurrence of "bush sickness" on the limed pasture, however, does not support the possibility of a lime deficiency being associated with "bush sickness." The analytical data confirm the results which have already been obtained by Aston⁽¹⁾ in his investigations of the "bush-sick" pastures of the Rotorua District.

Summary.

(1) Untreated pasture-samples from a number of different soil-types have shown on analysis that striking differences exist in their composition.

(2) There does not seem to be any very obvious correlation between the chemical data usually determined on soils and the mineral composition of the grass, except that abnormally low percentages of available phosphate in the soil are reflected in low percentages of phosphoric acid in the grass, while the lime-requirement figures give little information as to the probable lime content of the pasture.

(3) Judged by the standard of Godden's figures for English hill pastures, the pastures on the various Nelson hill soil-types appear to be good, since in all cases the percentages of the various constituents are somewhat higher in the Nelson series; especially is the difference remarkable in the nitrogen and total-ash and soluble-ash figures. In the poorest types of hill pastures (Moutere Hills and Kaiteriteri) the lime and phosphate contents compare closely with those given by Godden, yet it is certainly known that in the Moutere District serious stock ailments are found. The poorer pastures show low iron and high manganese contents, and are also distinguished by their high content of silica.

(4) The analyses show that the Nelson pastures considered satisfactory by stockmen differ in many respects from the English cultivated pastures analysed by Godden. In the Nelson pastures the phosphoric-acid content is in every case except one considerably higher than that of the lime, a reverse order to that found by Godden. In all cases also the potash, chlorine, nitrogen, total ash, and soluble ash are greater than Godden's average figures. The most striking result is the very high percentage of crude proteid found in these New Zealand pastures; as has been pointed out above, this far outstrips any of the available English figures, in one case reaching practically 36 per cent. The main constituents of these pastures have been perennial rye-grass and white clover, a mixture considered to be the ideal for pastures.

(5) A number of districts in the Waimea County are characterized by their poor results with stock. It is probable that a number of factors are operating, as the following considerations will show.

(a) The pastures of the Gordon fine sands have given poor results with stock, even with very light stocking. The soil is infertile, though neutral in reaction, so that only a very poor growth ensues. The low content of lime and high content of magnesia are outstanding features of the samples analysed.

(b) Samples of pasture from the Moutere Hills and the Kaiteriteri formations have been found to be low in lime, phosphoric acid, soluble ash, and nitrogen, and are distinguished from the pastures of other soil-types by the low percentage of iron and the high percentage

of manganese. On the former type of soil kidney trouble, with formation of xanthin calculi, is common.

(c) A large area of granite country in the vicinity of the Hope and Sherry Rivers is associated with definite symptoms of "bush sickness" in stock. The pasture-samples from Glenhope confirm the theory of "bush sickness" by their low contents of iron, especially in the autumn samples. The data presented show clearly the difference in the iron contents of pastures from fields known to be "sick" or "healthy." Starvation of the animals does not occur, as abundant feed is available; some of the other mineral constituents are low, but the controlling factor in the poor results obtained with stock appears to be the low iron content.

(d) The pastures of the Tahuna sands are distinguished by their leading to the development of "pica" among stock, and satisfactory results can only be obtained if lime and phosphate dressings are applied. Although all the minerals are present in low amounts the main deficiency appears to be in respect of the lime.

(e) The pastures of the Wakapuaka reclaimed area are distinguished by their low lime and iron contents and the high content of sodium and chloride. As the stock on this area have access to good pasture, no comment can be made as to the effect of this abnormal pasture on the health of the animals.

Conclusion.

In conclusion the writers express their indebtedness to Messrs. J. A. Bruce and L. Bishop for the assistance they have given in the collection of pasture-samples. The authors have drawn freely on the unpublished records of the soil survey of the Waimea County in describing the characteristic properties of the soil-types associated with the pastures discussed in this paper.

The work recorded in this paper has been carried out in connection with the Empire Marketing Board's scheme for pasture research within the Empire. The Empire Marketing Board and the New Zealand Research Council have contributed generously towards the cost of the investigation.

Wheat Research Institute.—The Chairman's report at the April meeting of the Research Council included the following reference to this activity: "Work at the Wheat Research Laboratory (Christchurch) is in full swing on investigations connected with the present season's grain. Some one thousand samples of wheats from all parts of the grain-growing districts of both Islands have been assembled at the Laboratory for physical, chemical, and baking tests. The Director's report dealing with the correct naming of a large number of varieties grown throughout Canterbury and Otago, together with the steps taken to certify good supplies of seed wheat, will help in the production of those desirable types of grain most useful to millers and bakers. Data compiled from the large area devoted this year to single-ear selections, yield trials and manurial trials, are now being worked up. Investigations concerning the use of additions such as milk products to flour used in bread-manufacture, and into causes of staleness in bread, also are being undertaken at the Laboratory.

BIOLOGICAL CONTROL OF PEAR-MIDGE (*PER- RISIA PYRI*) IN NEW ZEALAND.

THE PRESENT POSITION.

J. MUGGERIDGE, B.Sc., Fields Division, Palmerston North.

THE present article provides a brief summary of the work relating to the establishment in New Zealand of the pear-midge parasite *Misocyclops marchali* (Kieff),* including the past season of 1928-29. Proposals for the introduction of other parasites are also mentioned.

SEASON 1925-26.

The biological control of pear-midge in New Zealand commenced late in the 1925-26 season. This work was initiated by Dr. D. Miller (then Government Entomologist, but now of the Cawthron Institute), at whose instigation Dr. J. G. Myers was commissioned to make a survey of the position in France and, if possible, locate suitable parasites for despatch to New Zealand. Through Dr. Myers, and subsequently the Imperial Bureau of Entomology, consignments of the midge parasites arrived here in October, 1925. Summarizing, we find that a fair amount of this material was used for experimental purposes and liberation in the insectary in Mr. W. G. Williams's orchard at Henderson, and the remainder was liberated in the orchard.

SEASON 1926-27.

In this season further consignments of the parasites were forwarded by Dr. R. C. Fisher through the Imperial Bureau. In all five consignments arrived over a period from August to December. This material was used mainly to ensure establishment of the parasite, and subsequent events go to show that this was quite successful.

SEASON 1927-28.

No further importation of parasites was undertaken in 1927-28, since midge-infested material taken from Williams's orchard at Henderson showed conclusively that the parasite had overwintered and had apparently become successfully established.

Mr. W. Cottier, Assistant Entomologist, Department of Agriculture, was delegated to attend to midge work for part of this season. This involved mainly the distribution of parasitized material to various orchardists. A list of orchardists to whom material was sent was kept.

SEASON 1928-29.

It was felt that this season would be the critical one, and that should the parasite become effective it would now show up. The orchardists to whom parasitized material had been distributed during the summer of 1927-28 were circularized early in the season, asking them to forward midge-infested material so that we might determine whether the parasite had become established in their locality, and, if possible, also to determine the degree of parasitism. Most of those

* In previous articles in the *Journal* this insect has been referred to as *Platygaster*.

circularized responded well, and the material sent in was placed in emergence-boxes and records kept of parasites and midges. The results obtained are as recorded below:—

Emergence Box A: Material from Orchard Instructor, Hastings. About 70 midges emerged and no parasites.

Box B: Material from W. G. Williams's orchard, Henderson (where bulk of parasites liberated). Placed in emergence-box 30/10/28. First midges appeared 15/11/28; ceased emergence* 24/11/28. First parasite emerged 8/12/28, and a second parasite 10/12/28. In all 200 midges emerged and 2 parasites. Parasitism, 1 per cent.

Box B (i): Midge-infested material from W. G. Williams's orchard. Placed in box 8/11/28. First midges appeared 26/11/28; ceased emergence 10/12/28. One parasite appeared 3/1/29. Totals, 150 midges and 1 parasite. Parasitism, 0.6 per cent.

Box B (ii): Midge-infested material from W. G. Williams's orchard. Placed in box 22/11/28. First midges appeared 3/12/28; ceased emergence 18/12/28. First parasites observed 24/12/28, and continued to emerge up to 7/1/29. A few midges continued to emerge up to 10/1/29. Total, 800 midges and 45 parasites. Parasitism, 5.6 per cent.

Box B (iii): Material from W. G. Williams's orchard. Placed 28/11/28. Midges emerged 10/12/28; ceased emergence 24/12/28. Parasites appeared 4/1/29; ceased emergence 9/1/29. Total, 650 midges and 24 parasites. Parasitism, 3.69 per cent.

Box C: Material from A. L. Aicken, Avondale, Auckland. Placed 27/11/28. First midges emerged 12/12/28; ceased emergence 5/1/29. Total, 290 midges; no parasites.

Box D: Material from H. Dobbie, Epsom, Auckland. Placed 27/11/28. Midges emerged 10/12/28; ceased emergence 3/1/29. Total, 50 midges; no parasites.

Box D (i): Material from H. Dobbie, Epsom. Placed 1/2/29. Midges emerged 12/2/29; ceased emergence 17/2/29. Parasites emerged 11/3/29. Total, 100 midges and 2 parasites. Parasitism, 2 per cent.

Box E: Material from W. G. Morrison, Birkdale, Auckland. Placed 25/11/28. Midges emerged 13/12/28; ceased emergence 7/1/29. Total, 12 midges; no parasites.

Box F: Material from H. S. Izard, South Road, Auckland. Placed 28/11/28. Midges emerged 13/12/28; ceased emergence 5/1/29. Total, 450 midges; no parasites.

Box G: Material from Hopkins Bros., Auckland. Placed 28/11/28. Midges emerged 12/12/28; ceased emergence 3/1/29. No parasites.

Box H: Material from G. Battersby, Albany, Auckland. Placed 29/11/28. Midges emerged 14/2/28. No parasites.

Box I: Material from W. L. Heather, Whangarei. Placed 29/11/28. Midges emerged 13/12/28; ceased emergence 3/1/29. No parasites.

Box J: Material from A. Bush, South Road, Henderson. Midges emerged 13/12/28; ceased emergence 4/1/29. Total, 300 midges and 1 parasite. Parasitism, 0.33 per cent.

Box K: Material from W. Shaw, Warkworth. Placed 3/12/28. Midges emerged 20/12/28. No parasites.

Box L: Material from Miss Birtles, Huarau. Placed 11/12/28. Midges emerged between 24/12/28 and 3/1/29. Total, 400 midges; no parasites.

Box M: Material from J. O. Triggs, Auckland. Placed 21/12/28. Midges emerged between 24/12/28 and 3/1/29. Total, 10 midges; no parasites.

Box M (i): Material from J. O. Triggs, Auckland. Placed 14/2/29. Midges emerged 25/2/29; parasites emerged 15/3/29. Total, 20 midges and 6 parasites. Parasitism, 30 per cent.

Box N: Material from L. Padget, Auckland. Placed 4/12/28. Midges emerged 20/12/28; ceased emergence 7/1/29. No parasites.

* "Ceased emergence" means that the main batch of midges had emerged at the time stated; after this date only a scattered few midges appeared on odd occasions.

Box O: Material from W. and H. Hoey, Whangarei. Placed 19/12/28. Midges emerged between 24/12/28 and 3/1/29. No parasites.

Box P: Material from E. M. Bell, Auckland. Placed 1/2/29. Midges emerged 23/2/29. Total, 14 midges; no parasites.

Box Q: Material from C. C. Smithson, Tinopai. Placed 12/2/29. Sixteen midges emerged and no parasites.

These results are in keeping with the writer's field observations. A fair indication of the state of Mr. Williams's orchard is given by the accompanying photograph.



PEAR-TREE IN MR. W. G. WILLIAMS'S ORCHARD, HENDERSON, SHOWING TYPICAL CURLED CONDITION OF LEAVES DUE TO MIDGE-ATTACK.

Early in the season it became apparent that the parasite was not exercising the degree of control for which one hoped. But although the foregoing results present the parasite in a most unfavourable light, it is felt that definite conclusions are still to be avoided until a further series of tests has been carried out next season.

In Mr. Williams's orchard, where the main liberation of parasites took place, one hoped to find evidence of control, but such was not the case. Mr. Williams, who has been most willing to assist throughout, agreed to forward supplies of infested material from week to week.

Unfortunately, he was unable to keep up supplies for very long, owing to the fact that his trees were so severely affected by midge in the earlier part of the season that practically no growth was made afterwards.

To sum up, one can only say that for the past season (1928-29) the midge was not controlled by *Misocyclops marchali*. The exact reasons for this failure are difficult to define at the present juncture, though attention must be drawn to the fact that the times of emergence of the parasite and its host do not coincide. It has been noted that in all cases the main brood of midge had practically ceased emerging about a week, and sometimes longer, before the first parasite appeared. This, it is believed, is a constant feature, and it had also been noted by Mr. Cottier during his last season's work.

INTRODUCTION OF OTHER PARASITES PROPOSED.

In view of the fact that *M. marchali* has not exercised the control hoped for, it is intended to introduce other parasites that may be likely to effect a more satisfactory control. As a basis for further introductions, Dr. Myers's original investigation is valuable. His special mention of *Pilophorous perplexus* should receive primary consideration, for he states that "there can be no doubt that, during July and August at least, *Pilophorous* caused greater mortality among the midge larvæ than all other factors combined." Apart from a study of the life-history of this insect, one would like to know particularly how specialized in feeding-habits *P. perplexus* is. Myers points out in this connection that "many groups of *Miridae* are much more thoroughly carnivorous than is generally supposed." It is also felt that the introduction of *Torymus abbreviatus* should be undertaken, and it is hoped to effect this for next season.

Dr. G. A. K. Marshall, of the Imperial Bureau of Entomology, has accordingly been communicated with, requesting an estimate of a study of the food habits of *P. perplexus*, with a view to its introduction, and also the possibility of our securing supplies of *T. abbreviatus*.

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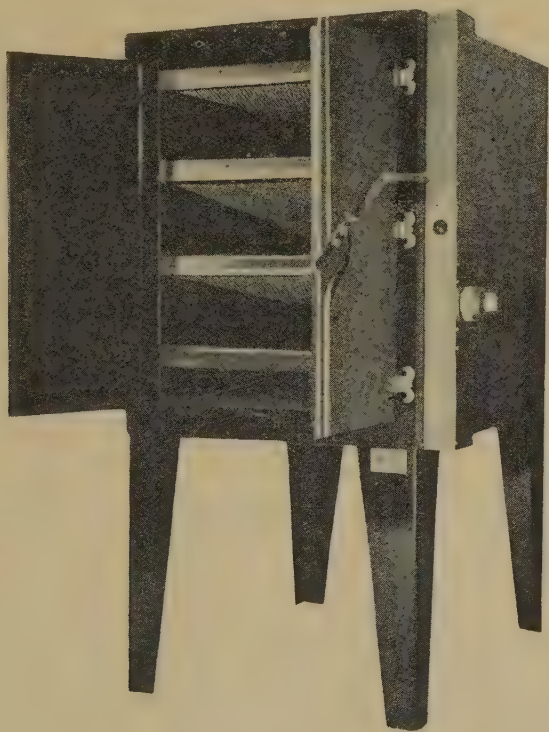
Phormium Research.—Work on plant selection and hybridization is proceeding under Dr. Yeates at Massey College. A fibre-strength-testing machine is available for making tests of the fibre produced from selected and hybridized phormium.

TREATMENT OF HONEYCOMB CAPPINGS.

AN ELECTRIC OVEN MELTER.

E. A. EARP, Senior Apiary Instructor, Horticulture Division.

THERE are a number of melters on the market which facilitate the messy and unpleasant job of dealing with cappings in the apiary. These contrivances are mostly heated by steam, and can be operated when uncapping the combs; thus much labour is saved and the wax and honey segregated. However, with the great advance made in the supply of electric power to rural districts many beekeepers can now



THE ELECTRIC OVEN MELTER.

dispose of their cappings by this agency, either with an electrically heated box or by means of a special oven. Both types of heaters have proved to be a great boon where adopted.

The electric oven here illustrated was made recently to the order of Mr. W. B. Bray, a Banks Peninsula apiarist, by a Christchurch firm. The apparatus is not patented. The oven is large enough to deal with the cappings from about 1 ton of honey in one charge, and with the aid of a clock to cut out the power in the night a second lot could be done while one slept.

The wax is obtained in one solid cake, which only needs washing and a light scraping to be ready for market. The cappings are drained for a day before being put in the oven on trays which slide in. According to the amount of draining, there will be from 60 lb. to 100 lb. of honey obtained in the melter. This honey is equal in grade to the bulk, as it is not injured by the heat it undergoes or by coming into contact with hot slumgum. It is this slumgum which, coming into contact with the honey, stains or darkens its colour and impairs its flavour. The honey runs away first, then the wax, and the slumgum is left on cloths on the screens in the trays.

The increased value of the honey saved, or the saving through there being no loss of value on it, amounts to at least 10s. to 15s. every time the melter is used with a full charge. The power used costs 1s. to 1s. 6d., according to local rates, so the direct saving is considerable. Indirectly the advantages are considerable. The cappings can be dealt with daily at a considerable saving in time, the melter needing no attention once the power is turned on. There is no danger of fire as with boilers and lamps. The wax is ready for market, and there is no risk of damaging the honey as is the case with some melters in use.

The electric oven melter seems, indeed, to have come to revolutionize the cappings problem in commercial apiaries. In operating it the main thing to learn is how long to run the power for the quantity of cappings. The best way is to load it, say, nearly full, and run it a few hours before opening it for examination. It should be run till nearly all the wax has left the slumgum, but not so long as to darken the film of honey that remains on the trays under the screens. After the power has been turned off the oven should be left closed for thirty minutes to an hour to allow more wax to drain out, then opened up to remove the cloths from the screens before they set too hard. The cloths should be soaked in hot water, rinsed, and put away till sufficient accumulate, when they can be boiled up, pressed, washed, and dried for use again. Ordinary cheese-binding should be used for the cloths on the screens.

Commercial beekeepers who have tried the electric method consider that it is away ahead of all others. The chief advantages of the electric oven melter may be summarized as follows: (1) It distributes the heat evenly over the surface of the cappings. (2) It heats all three trays evenly by increasing the heat successively of each lower shelf. (3) The oven can be used for other purposes, such as liquifying 60 lb. tins of honey by the removal of some of the trays and the adjusting of the others on the level; any or all of the trays can be adjusted to a level position. (4) It is constructed to get maximum results from the power used, the oven being insulated with silicate cotton to conserve the heat generated. (5) It is economical in space.

Dairy Research.—Investigations at the Dairy Research Institute, Palmerston North, are being concentrated on the problem of open texture in cheese. Investigations of losses in vitamins occurring during manufacturing processes in dairy factories have been commenced.

THE OFFICIAL SEED-TESTING STATION.

RECORD OF OPERATIONS FOR 1928.

N. R. FOY, Seed Analyst, Fields Division, Palmerston North.

DURING the calendar year 1928 a total of 10,149 samples were received for testing at the Agriculture Department's Seed-testing Station, this representing a decrease of 619 on the number received for the preceding year. The aggregate was made up as shown in Table 1. The smaller number of rye-grass and clover samples received accounts for almost the whole of the total decrease.

The number of samples received during each month is shown in Table 2, and Table 3 gives the actual tests made and the number of samples submitted for purity or germination or both. Table 4 shows the number of samples received from the different land districts and centres therein. Table 5 gives the number of samples of the various species received for test, and the number of tests made for each species.

GRASSES.

The average purity and germination for the main grasses are given in Table 6, together with the percentage of samples germinating in groups of tens. With certain exceptions, the purity and germination averages compare favourably with those of previous years.

Rye-grasses.—Little improvement was shown in the general average germination for perennial rye-grass. In 1924 and 1925 averages of 86 and 85 per cent. were recorded, with over 40 per cent. of the samples germinating in the 90's. The average fell in 1926 to 77 per cent., with 20 per cent. in the 90's; and in 1927 to 75 per cent., with 9 per cent. of the samples in the 90's. In 1928 a slight improvement was shown in Southern and Sandon seed, but this was offset by the depression in the Hawke's Bay and Canterbury samples. Hawke's Bay is usually a high-germinating seed, but in 1928 nearly half of the samples received germinated under 70 per cent. For both Italian and Western Wolths rye-grasses the germination was shown to be slightly lower than in previous years. In general the purity of all the rye-grass samples was of a high standard. Awned Italian occurred in quantities ranging from 0.5 up to 25 per cent. in samples labelled "rye-grass"; 84 per cent. of the Southern samples and 86 per cent. of the Canterbury samples, 75 per cent. of the Sandon samples, and 45 per cent. of the Hawke's Bay samples contained awned seed of Italian rye-grass. Were it possible to accurately and quickly distinguish between perennial and "de-awned" Italian, these percentages would no doubt be greater. Ergot sclerotia occurred in 54 per cent. of the perennial seed examined, ranging from traces up to 25 per cent. Less than 1 per cent. of the Italian and Western Wolths samples contained ergot.

Cocksfoot.—The average germination of 68 per cent. recorded in 1928 is about the general standard for cocksfoot, Danish being the usual 8 or 10 per cent. higher. The average percentage of impurities (5 per cent.) is higher than for five years past, the high rye-grass content of

Table 1.—Origin of Samples received, 1927 and 1928.

Senders, &c.	Number of Samples.		Increase or Decrease in 1928.
	1928.	1927.	
Seed-merchants	8,509	8,959	450 decrease.
Farmers and seed-growers	206	233	27 decrease.
Government Departments	365	351	14 decrease.
Laboratory tests	890	1,078	188 decrease.
Retests	115	147	32 decrease.
Totals	10,149	10,768	..

Table 2.—Number of Samples received in each Month, 1928 and 1927.

Month.	Number.		Month.	Number.	
	1928.	1927.		1928.	1927.
January	666	490	July	881	892
February	871	682	August	925	1,258
March	1,086	1,038	September	727	1,412
April	872	776	October	995	1,007
May	950	1,000	November	870	982
June	984	753	December	322	478

Table 3.—Classification and Numbers of Samples and Tests, 1928 and 1927.

Classification.	Number.	
	1928.	1927.
Samples for germination only	7,555	7,641
Samples for germination and purity	2,505	2,868
Samples for purity only	89	259
Purity tests made	2,594	3,127
Germination tests made	10,060	10,509
Totals	12,654	13,636

Table 4.—Number of Samples from the different Land Districts and Centres therein, 1928 and 1927.

Land District, &c.	1928.	1927.	Land District, &c.	1928.	1927.
Southland (total)	2,950	3,377	Auckland (total)	1,191	1,066
Gore	1,417	1,493	City	974	900
Invercargill	1,405	1,774	Other	217	166
Other	168	110	Otago (total)	732	602
Wellington (total)	2,221	2,323	Dunedin	698	549
City	1,055	1,301	Other	34	33
Palmerston North and Feilding	779	672	Marlborough	174	228
Other	387	350	Hawke's Bay	238	213
Canterbury (total)	1,189	1,680	Taranaki	328	129
Christchurch	667	1,073	Gisborne	23	47
Other	522	607	North Auckland	..	24
			Nelson	13	1
			Westland	..	..

Akaroa seed (average impurity 6 per cent.) being mainly responsible for the increase. Rye-grass occurred in 98 per cent. of the samples of Akaroa seed examined, ranging from 0.1 up to 8 per cent. *Poa pratensis* occurred in 68 per cent. of the Akaroa samples examined. The cocksfoot sample in general was entirely free from seeds of noxious weeds, as was also Akaroa seed from the indicator impurities of Danish cocksfoot. In previous years a number of samples marked "Akaroa" have contained seeds of ox-eye daisy, field foxtail, chamomile, and mayweed, the combined presence of which is a positive indication of imported seed. No doubt the legislation requiring the staining of all imported cocksfoot - seed has effectively prevented the blending of Danish and Dominion lines.

Crested dogstail.—The quality of the 1928 crop was excellent, 85 per cent. of the samples received germinating in the 90's. The seeds of

Table 5.—Number of Samples of various Species tested, 1928 and 1927, and Number of Tests made thereon, 1928.

Species.	1928.			1927.
	Germination Tests.	Purity Tests.	Samples.	Samples.
Perennial rye-grass (<i>Lolium perenne</i>) ..	2,285	485	2,292	2,748
Italian rye-grass (<i>Lolium multiflorum</i>) ..	406	81	406	450
Western Wolthys rye-grass (<i>Lolium westwoldicum</i>) ..	186	29	186	160
Cocksfoot (<i>Dactylis glomerata</i>) ..	430	110	433	501
Crested dogstail (<i>Cynosurus cristatus</i>) ..	941	520	954	1,187
Chewings fescue (<i>Festuca rubra</i> var. <i>fallax</i>) ..	661	439	678	697
Brown-top (<i>Agrostis tenuis</i>) ..	355	239	357	217
Danthonia pilosa ..	68	33	69	93
Danthonia semi-annularis ..	3	1	3	3
Timothy (<i>Phleum pratense</i>) ..	121	39	123	86
Fog (<i>Holcus lanatus</i>) ..	30	17	31	30
Meadow fescue (<i>Festuca pratensis</i>) ..	25	6	26	33
Meadow foxtail (<i>Alopecurus</i>) ..	37	12	37	21
Paspalum (<i>Paspalum dilatatum</i>) ..	71	13	71	83
Poa pratensis ..	52	20	52	36
Poa trivialis ..	12	6	12	9
Prairie-grass (<i>Bromus unioloides</i>) ..	20	..	20	19
Fiorin (<i>Agrostis stolonifera</i>) ..	6	4	7	7
Red-top (<i>Agrostis palustris</i>) ..	7	3	7	11
Yarrow (<i>Achillea millefolium</i>) ..	47	41	48	10
Other grasses ..	14	1	15	15
Total grasses ..	5,777	2,099	5,827	6,506
White clover (<i>Trifolium repens</i>) ..	411	200	413	444
Cow-grass and red clover (<i>Trifolium pratense</i>) ..	298	97	300	495
Alsike (<i>Trifolium hybridum</i>) ..	71	30	73	54
Alsike and white clover ..	16	5	16	24
Subterranean clover (<i>Trifolium subterraneum</i>) ..	34	8	35	30
Strawberry clover (<i>Trifolium fragiferum</i>) ..	4	..	4	4
Crimson clover (<i>Trifolium incarnatum</i>) ..	44	3	44	24
Suckling clover (<i>Trifolium dubium</i>) ..	34	15	34	30
Lucerne (<i>Medicago sativa</i>) ..	104	22	105	85
English trefoil (<i>Medicago lupulina</i>) ..	30	6	30	34
Lotus major ..	79	45	82	58
Lotus hispidus ..	20	6	20	14
Other clovers, &c. ..	8	..	8	2
Total clovers ..	1,153	437	1,164	1,298

Table 5—continued.

Species.	1928.			1927.
	Germination Tests.	Purity Tests.	Samples.	Samples.
Swede (<i>Brassica campestris</i>)	334	71	334	292
Turnip (<i>Brassica rapa</i>)	412	94	412	433
Rape (<i>Brassica napus</i>)	91	17	91	153
Kale (<i>Brassica acephala</i>)	104	5	104	115
Mustard (<i>Brassica arvensis</i>)	24	3	24	19
Mangel (<i>Beta vulgaris</i>)	235	50	235	201
Carrots (<i>Daucus carota</i>)	101	8	101	149
Total roots	1,301	248	1,301	1,342
Oats (<i>Avena sativa</i>)	28	..	28	29
Wheat (<i>Triticum vulgare</i>)	16	..	16	3
Barley (<i>Hordeum vulgare</i>)	15	..	15	74
Rye-corn (<i>Secale cereale</i>)	6	..	6	5
Tares and vetches (<i>Vicia</i> spp.)	4	..	4	6
Peas (<i>Pisum sativum</i>)	197	..	197	144
Japanese millet (<i>Echinochloa frumentacea</i>)	23	4	23	14
Other forages	10	..	10	6
Vegetables (other than peas)	386	..	386	280
Flower-seeds	77	..	77	..
Forest-tree seeds	117	..	117	121
Seed mixtures	42	33	50	34
Grand totals.. .. .	9,158	2,821	9,221	9,862

Californian thistle occurred in 33 per cent. of all samples; in 34 per cent. of Southern and 37 per cent. of Sandon samples; the rate of occurrence was from two up to 250 seeds per ounce, and the average rate of occurrence twelve seeds per ounce. In general dogstail samples showed good colour, which may be taken as evidence of a fairly complete maturity.

Chewings fescue.—Nearly 70 per cent. of the samples received germinated in the 90's, with a general average of 82 per cent., which is slightly lower than that of the previous year. Colour and degree of maturity appeared to be good. Purity generally was excellent, but 92 per cent. of the samples contained catsear (*Hypochaeris radicata*), which was by far the most constantly occurring impurity.

Brown-top.—The 1928 season's brown-top was of excellent quality, both as regards purity and germination. The average pure-seed content of 91 per cent. for all samples is a considerable improvement over the 67 per cent. in 1926 and 84 per cent. in 1927. Southern seed gave the highest average purity of 96 per cent., with Canterbury 94 per cent. and Waipu 72 per cent. pure seed. All brown-top samples are now tested on the Continental system, so that senders of samples are now able to make accurate estimations as to quality and value on receipt of report. The "pure germinating seed" percentage given is the only single percentage upon which value can be estimated, or upon which two samples may be compared value for value. The most constantly occurring weed impurities were toad-rush (*Juncus bufonius*)—in 90 per

cent. of the samples; and mouse-eared chickweed (*Cerastium vulgatum*)—in 59 per cent. of the samples. About 15 per cent. of the samples showed seed infected with *Tilletia decipiens*.

Other Grasses.—The seed of timothy, *Poa pratensis*, *Danthonia* spp., and *paspalum* was of average quality, although 60 per cent. of the samples of the last-named germinated over 50 per cent.

The average germination percentages of the grass-seeds not mentioned in Table 6 were as follows:—

<i>Danthonia semi-annularis</i> ..	50	<i>Ratstail</i> ..	80
<i>Fog</i> ..	91	<i>Prairie-grass</i> ..	84
<i>Poa trivialis</i> ..	50	<i>Fiorin</i> ..	73
<i>Yarrow</i> ..	58	<i>Red-top</i> ..	82
<i>Sheep's fescue</i> ..	45	<i>Indian doob</i> ..	86
<i>Poa nemoralis</i> ..	35		

CLOVERS AND RELATED SPECIES.

The average germination and purity of the main clovers and related species is shown in Table 8. The general averages vary but little from those of previous years.

White clover.—Suckling clover occurred in 90 per cent. of the samples of white clover at the rate of 1 up to 40 per cent. Rib-grass, sorrel, catchfly, and scarlet pimpernel occurred in 75, 88, 32, and 57 per cent. of the samples respectively. Dodder occurred in 2 per cent., and in small quantities only. Table 9 shows the rate of occurrence of the main impurities for all samples, New Zealand white, New Zealand wild white, and imported white clovers respectively. With the exception of

Table 6.—Average Germination and Percentage of Extraneous Seeds for the Main Grasses, 1928.

The figures in parentheses in second column are 1927 averages.

Species.	Germination Percentage.			Percentage of Samples germinating in Groups—							Average Percentage of Impurities.	
	Average.	Maximum.	Minimum.	0-49.	50-59.	60-69.	70-79.	80-89.	90-100.	Commercial Seeds.	Weed-seeds.	
Perennial rye-grass	75 (75)	99	5	7	6	15	28	33	11	1.3	0.6	
Italian rye-grass ..	78 (84)	98	17	1	4	15	26	34	20	0.5	0.7	
Western Woltis ..	79 (82)	100	36	4	2	12	28	36	18	0.2	0.3	
Cocksfoot	68 (70)	94	2	5	16	30	30	14	5	4.1	0.9	
Crested dogstail ..	90 (91)	100	9	1	1	1	2	10	85	1.2	0.2	
Chewings fescue ..	82 (86)	100	0	5	2	3	7	16	67	0.3	0.1	
Brown-top	87 (85)	100	12	3	4	4	6	15	68	0.1	0.6	
Timothy ..	81 (88)	100	28	13	8	5	3	7	64	0.2	0.1	
Meadow-fescue ..	78 (74)	98	28	20	..	12	..	8	60	0.4	1.8	
Poa pratensis ..	64 (57)	79	20	6	27	42	21	4	0	0.5	0.1	
				0-19.	20-29.	30-39.	40-49.	50-59.	60-100.			
Danthonia spp. ..	49 (52)	89	0	3	4	12	22	24	35	11.2	9.2	
Meadow-foxtail ..	31 (18)	63	4	22	16	39	15	5	3	12.7	27.2	
Paspalum ..	47 (41)	69	13	4	11	11	27	21	26	0.0	0.1	

Table 7.—Average Germination and Purity of Perennial Rye-grass, Crested Dogstail, Cocksfoot, and Chewings Fescue, grouped according to Place of Origin, 1927 and 1928.

Origin.	Average Per- centage of Im- purities.	Percentage of Samples germinating in Groups—								Average Germina- tion.		Number of Samples.	
		Under 70.		70-79.		80-89.		90-100.					
		1927.	1928.	1927.	1928.	1927.	1928.	1927.	1928.	1927.	1928.	1927.	1928.
<i>Perennial Rye-grass.</i>													
Dominion	1.9	26	28	33	28	32	33	9	11	75	76	2,713	2,285
Southern ..	1.8	29	23	36	29	32	38	3	10	74	76	1,737	1,497
Canterbury	1.0	18	30	25	28	35	29	22	13	80	74	441	336
Sandon ..	1.6	26	20	31	26	33	23	10	21	74	76	154	117
Hawke's Bay	..	18	49	7	23	38	15	37	13	83	68	100	101
<i>Cocksfoot.</i>													
Dominion	5.0	44	51	33	30	20	14	3	5	70	68	492	430
Danish ..	1.6	16	25	38	44	44	31	2	0	76	74	124	96
Akaroa ..	6.1	73	74	23	19	4	7	0	0	63	64	127	116
Plains ..	3.8	41	31	31	31	20	27	11	11	71	75	54	45
<i>Crested Dogstail.</i>													
Dominion	1.4	4	3	4	2	12	10	80	85	91	90	1,163	941
Southern ..	1.3	2	1	4	2	12	9	82	88	92	94	987	789
Sandon ..	0.6	3	2	1	8	6	19	90	71	94	90	89	85
<i>Chewings Fescue.</i>													
Southern ..	0.4	5	6	9	4	16	7	70	16	86	82	670	661

Table 8.—Average Germination and Purity of the Main Clovers and Related Species, 1928.

The figures in parentheses in second column are 1927 averages.

Species.	Percentage of Germination.			Percentage of Samples germinating between				Seed Impurities.				Average Percentage of Hard Seeds.
	Average.	Maximum.	Minimum.	0-69.	70-79.	80-89.	90-100.	Number of Species.		Average Percentage.		
								Com-mercial Seeds.	Weed-seeds.	Com-mercial Seeds.	Weed-seeds.	
White clover ..	84 (86)	99	5	13	15	33	39	14	54	3.7	0.7	11.0
Cow-grass ..	86 (87)	100	7	7	7	20	66	19	41	0.4	0.6	5.6
Alsike ..	88 (82)	99	74	1	9	41	49	11	22	1.6	0.2	5.4
Subterranean clover	86 (88)	99	72	9	26	18	47	2	4	0.1	0.5	11.7
Strawberry clover	72 (65)	81	66	0	25	51	24	..	..	..	..	25.0
Crimson clover ..	55 (77)	100	9	51	14	14	21	5	8	0.2	0.2	0.1
Suckling clover ..	66 (60)	94	14	48	32	8	12	12	30	18.4	4.4	21.0
Lucerne ..	80 (75)	99	26	22	23	25	30	10	21	0.7	0.1	14.3
English trefoil ..	68 (64)	94	8	36	20	27	17	4	9	0.1	0.1	2.6
Lotus major ..	76 (70)	96	20	30	25	27	18	19	43	6.2	0.6	13.4
Lotus hispidus ..	53 (53)	86	32	90	5	5	0	13	17	11.0	6.3	37.8

Trifolium arvense, note the lesser occurrence of the annual species of wild white, also the non-occurrence of *Silene gallica* and *Trifolium arvense* in imported white, and the non-occurrence of *Silene noctiflora* in New Zealand seed. Of the total samples examined 25 per cent. contained cluster clover, which impurity was present in most of the seed grown in Hawke's Bay, several samples containing over 30 per cent. A number of samples received labelled "clover-seed" consisted of suckling, haresfoot trefoil, clustered clover, and hop trefoil, in varying percentages, with a slight trace of white clover.

Other Clovers.—The germination percentages of other clover-seeds, not included in Table 9, were as follows:—

						Hard Seeds.
Alsike and white (mixed)	..	..	..	..	73	10
Lotus corniculatus	..	..	..	..	70	5
Sweet clover	..	..	..	..	45	20

Table 9.—Occurrence of Main Impurities in White Clovers, 1928.

The figures signify the number of samples in each 100 examined which contained the individual impurity.

Impurity.	All Samples.	N.Z. White.	N.Z. Wild White.	Imported White.
<i>Commercial Seeds.</i>				
<i>Trifolium dubium</i>	90	93	100	44
<i>Trifolium hybridum</i>	77	89	83	80
<i>Trifolium pratense</i>	69	77	42	65
<i>Phleum pratense</i>	23	20	8	56
<i>Holcus lanatus</i>	31	32	20	10
<i>Medicago lupulina</i>	20	15	16	90
<i>Lolium</i> spp. (kernels)	32	41	29	21
<i>Lotus major</i>	3	1	..	..
<i>Phalaris</i> spp.	1	2	..	..
<i>Weed-seeds.</i>				
<i>Rumex acetosella</i>	88	84	83	89
<i>Plantago lanceolata</i>	76	82	42	78
<i>Chenopodium album</i>	44	49	42	45
<i>Anagallis arvensis</i>	57	72	38	5
<i>Silene gallica</i>	38	36	29	..
<i>Stellaria media</i>	21	18	..	70
<i>Prunella vulgaris</i>	17	12	..	45
<i>Cerastium vulgatum</i>	17	17	8	10
<i>Sisymbrium officinale</i>	8	4	..	10
<i>Spergula arvensis</i>	17	11	8	24
<i>Trifolium arvense</i>	22	23	38	..
<i>Plantago major</i>	6	1	4	..
<i>Polygonum aviculare</i>	2	1	..	..
<i>Cuscuta trifolii</i>	2	1	..	..
<i>Anthoxanthum odoratum</i>	7	5	4	..
<i>Silene noctiflora</i>	4	..	..	80
<i>Rumex crispus</i>	7	2	4	..
<i>Sherardia arvensis</i>	8	8	4	..
<i>Crepis capillaris</i>	4	1	..	..
<i>Geranium pusillum</i>	2	..	..	15
<i>Myosotis arvensis</i>	2	..	..	25
<i>Trifolium glomeratum</i>	8	2	..	..

ROOTS AND CRUCIFEROUS FORAGES.

The average germination figures for this group are shown in the following table:—

Table 10.—Average Germination Percentages of Roots and Cruciferous Forages, 1928 and 1927.

	Germination.				Percentage of Samples germinating between									
	Average.		Max.	Min.	1-59.		60-69.		70-79.		80-89.		90-100.	
	1928.	1927.	1928.	1928.	1928.	1927.	1928.	1927.	1928.	1927.	1928.	1927.	1928.	1927.
Swede ..	84	81	100	2	6	4	4	10	12	21	25	29	53	36
Turnip ..	88	83	100	6	4	5	2	10	6	15	19	34	68	36
Rape ..	92	89	100	11	1	2	2	4	3	5	18	24	76	65
Kales ..	81	80	99	10	10	6	12	10	12	16	30	31	36	37
Mangel ..	76	83	92	40	9	3	16	18	32	28	34	32	9	9
Carrot ..	61	60	90	30	44	44	23	28	13	15	11	10	9	2

VEGETABLE-SEEDS.

The average germination percentages of vegetable-seeds tested were as follows: Asparagus, 24; beet, 72; broccoli, 74; brussels sprouts, 97; beans, 85; cabbage, 83; cress, 90; cauliflower, 73; celery, 52; cucumber, 85; lettuce, 96; leek, 89; melon, 84; marrow, 83; onion, 62; parsley, 70; pumpkin, 69; parsnip, 75; radish, 75; rhubarb, 67; spinach, 52; squash, 88; tomato, 86.

CEREALS, ETC.

Following were the average germination percentages of this group: Oats, 89; wheat, 98; barley, 93; ryecorn, 60; maize, 92; tares, 95; millet, 69; lupins, 95.

FLOWER-SEEDS.

Flower-seeds tested gave the following average germination percentages: Cornflower, 72; pansy, 46; Aquilgia, 15; larkspur, 47; coreopsis, 22; Phlox Drummondi, 67; verbena, 25; candytuft, 66; Myosotis, 30; Campanula, 25; Aster, 42; Calleopsis, 50; Nemesis, 66; Linum, 36; Mathiola, 60; Salvia, 34; Physalis, 36; Viola, 26; Antirrhinum, 46; Linaria, 50; Anemone, 66; Eschscholtzia, 68; Schizanthus, 84; Nemophila, 16; Clarkia, 44; Arctotis, 34; Penstemon, 45; Delphinium, 66.

FOREST-TREE SEEDS.

A number of samples of forest-tree seeds were tested during the year, and the average germination percentages for twenty-three species can be supplied to persons interested.

EXPORT AND IMPORT OF SEEDS.

Table 11 shows the quantities of seed exports and imports for the years 1925, 1926, 1927, and 1928, together with the values for the latter year. Points of special interest are: Decrease in export of cow-grass

Table II.—Export and Import of Grass and Clover Seeds, 1925 to 1928.

Species.	1925.	1926.	1927.	1928.	
				Quantity.	Value.
Exports.					
	Cwt.	Cwt.	Cwt.	Cwt.	£
Cow-grass	4,253	4,657	9,628	1,495	8,433
White clover	647	2,115	2,388	835	6,526
Other clovers	985	717	928	350	1,768
Total clovers.. ..	5,885	7,489	12,944	2,680	16,727
Brown-top	514	475	301	1,131	10,078
Chewings fescue	7,483	13,923	17,418	17,124	71,247
Crested dogstail	3,985	2,309	5,434	4,844	20,769
Rye-grass	23,241	29,546	50,162	20,581	24,117
Cocksfoot	*	*	*	496	2,755
Other grasses	5,071	4,685	4,489	3,382	15,763
Total grasses.. ..	40,298	50,938	77,804	47,558	144,729
Total grasses and clovers	46,183	58,427	90,748	50,238	..
Total value	£155,029	£203,798	£257,136	£161,456	£161,456
Imports.					
Red clover	*	*	*	762	3,575
White clover	*	*	*	1,748	11,299
Alsike	*	*	*	2,806	15,385
Other clovers	*	*	*	1,497	10,988
Total clovers.. ..	6,451	8,283	2,657	6,813	41,257
Cocksfoot	10,091	15,616	5,619	9,145	34,210
Lucerne	1,027	575	527	17	281
Paspalum	1,378	1,717	1,940	3,026	17,598
Rye-grass	40	334	69	20	33
Timothy	4,142	1,989	2,905	4,765	7,568
Poa pratensis	*	*	*	51	339
Other grasses	3,004	3,604	1,741	1,839	10,087
Total grasses.. ..	19,682	23,835	12,801	18,863	60,116
Total grasses and clovers	26,133	32,118	15,458	25,676	101,373

* Figures not available.

and white clover for 1928, due to poor crops; increase in export of brown-top; decrease in import of lucerne; increase in import of paspalum.

Certificate of Record and Official Herd-test.—The testing of purebred dairy cows continues to hold up well this year. C.O.R. breeders testing in April numbered 226, some 638 cows having been tested. The corresponding figures for April, 1928, were 176 breeders and 547 cows. The number of breeders participating in the Official Herd-test during the month was 119, and these tested 1,486 cows, as compared with 105 breeders testing 1,332 cows in the same month a year ago

JERSEY C.O.R. BULL NGAHIWI SILENT KNIGHT.

W. M. SINGLETON, Director of the Dairy Division, Wellington.

THE Jersey bull Ngahiwi Silent Knight bears the distinction of being the first C.O.R. champion butterfat bull whose sire is also a similar champion. Ngahiwi Silent Knight was bred and is owned by Mr. W. J. Freeth, of Pukearuhe, Taranaki, and is a son of Grannie's Knight, a Jersey sire well known throughout New Zealand. Mr. Freeth has been granted certificates for eleven daughters of Ngahiwi Silent Knight, and their performances have certainly been very creditable. All eleven commenced test in the junior two-year-old class, and a classification of their certificates-of-record shows that three produced over 400 lb. butterfat, three over 450 lb., four over 500 lb., and one over 550 lb.



NGAHIWI SILENT KNIGHT.

Grannie's Knight has no less than fifty-six C.O.R. daughters to his credit, which is the largest number sired by any one C.O.R. bull up to the present. More than twenty of his daughters have gained certificates on productions exceeding 500 lb. butterfat, and one of his daughters, Holly Oaks Annie, with 1,056 lb. butterfat, is New Zealand's champion C.O.R. Jersey cow. Grannie's Knight was sired by K.C.B., who is generally admitted to be one of the best Jersey bulls we have had in the Dominion.

The dam of Ngahiwi Silent Knight is Mr. Freeth's Treasure Trove (bred by Mr. John Hale of New Plymouth), who gained a C.O.R. for 571.26 lb. butterfat. Treasure Trove is by Miro Meadow's Boss (sire of five C.O.R. daughters, three of which produced over 500 lb. butterfat) from Treasure's Dot, who has a C.O.R. for 565.05 lb. butterfat. Miro Meadow's Boss is by Admiral of Puketapu (sire of nineteen C.O.R.

daughters) from Waif, who, although not tested, is said to have been a very fine old cow. She was descended from Silky and Marquis. Treasure's Dot is by Soumise Tom, another champion butterfat bull, and a son of Soumise Majesty.

This brief summary is sufficient to show that Ngahiwi Silent Knight's pedigree is an unusually strong one from the point of view of production records. It is an old saying that heredity is the basis of successful breeding practice. Ngahiwi Silent Knight appears to be a concentration of those factors which are most desirable—high production and the ability to transmit it.

ASHBURTON EXPERIMENTAL FARM.

NOTES ON OPERATIONS, SEASON 1928-29.

R. MCGILLIVRAY, Fields Superintendent, Christchurch, and J. G. MCKAY,
Farm-manager, Ashburton.

THE principal work at the Ashburton Experimental Farm during the past season was that of wheat selection, and the growing of trial lines in connection with potato certification. Brief notes on these and other operations are recorded below.

WHEAT VARIETIES.

During the 1926-27 season Mr. J. W. Hadfield, Agronomist, made selections from a number of wheat varieties. A head-to-row trial was conducted in the 1927-28 season; from that trial the most promising strains were selected, and the following varieties were put on a yield trial: Velvet Chaff, Hunter's, Dreadnought, Solid-straw Velvet, Major, White-straw Tuscan, Solid-straw Tuscan.

Velvet Chaff, Hunter's, Dreadnought, and Solid-straw Tuscan were autumn-sown, and the remainder were sown in August. The residue of seed from each selection was sown in larger plots adjoining the variety trials. All plots were hand-harvested, and threshed with a small electrically driven peg-tooth thresher, which did excellent work. Bulk lines from the best strains are being dressed for future sowings. All seed used in the various trials was treated by the hot-water method and with Semesan by Mr. J. C. Neill, Field Mycologist. Weather and soil conditions were favourable during the brairding-period, and germination was distinctly high. On both autumn- and spring-sown plots occasional small patches were affected by take-all, while white-head and wheat-scab were in evidence more or less on all Solid-straw Tuscan plots. The presence of take-all was probably due to soil-infection, as, although the block was in potatoes the previous year, three consecutive wheat crops had been taken prior to that. Damage done by the scab was apparently negligible, as some of the worst-affected selections produced grain of good quality, and in some cases superior to grain produced from practically scab-free lines.

A miscellaneous collection of other varieties was grown for identification and selection purposes as follows: Pearl, Red Fife, Marquis,

White-straw Tuscan, Marquis No. 4, Garnet $\times$ Canada. A number of off-types were observed in the last two varieties mentioned, and selections were made to determine whether these were the result of breaking or simply rogues.

A selection of Marquis known as Marquis 10 B was received from Canada and autumn-sown on light land at the rate of 1 bushel per acre. The crop threshed 30 bushels per acre, which may be considered quite satisfactory. In habit of growth this selection was very similar to the original Marquis, and the straw had a slight tendency towards weakness in the later stages of growth. The grain produced, though somewhat smaller than the local Marquis, is larger than the parent seed, but less flinty.

A line of Dreadnought rogued in 1925 was grown on the farm during the season, in continuation of a practice extending over several years, for the purpose of supplying seed to certain farmers in North Otago, where the variety is in favour. As a result of this crop following wheat, take-all developed to a serious extent, and it has therefore been decided to scrap the whole line.

WHEAT SEED-TREATMENT TEST.

A "treatment of seed" trial with wheat to determine the effect of various treatments on germination and yield was conducted on an area used for variety trials in the preceding season. The various treatments and rates of seeding (sown with twenty-two replications) were as follows:—

	Seed sown per Acre.
Semesan, 2 oz. per bushel	90 lb.
Semesan, 2 oz. per bushel	105 lb.
Bluestone, 1 lb. to 10 gallons water	105 lb.
Copper carbonate, 3 oz. per bushel	105 lb.
Formalin, 1 pint to 60 gallons water	105 lb.
Untreated seed	105 lb.

In all treatments, except bluestone, germination was practically the same. Bluestone showed a considerable lowering of germination on all plots. Indications from plot-yields were not sufficiently conclusive to warrant publication, and further work will be undertaken to determine the relative relation of treatments to yield.

POTATO CERTIFICATION LINES.

An area of 4 acres was under these trials, and approximately 177 lines entered for certification were grown on the farm. In order to more definitely test the cropping-powers of each line a system of plot-replication was adopted. Each lot of one hundred sets was divided into five lots and planted in different localities in the field. The increasing interest taken by farmers in potato certification and their expressed appreciation of the Department's work along the lines of potato-improvement is most encouraging. Various selections of different varieties were also grown on the farm, and short rows of tubers affected with various virus and other diseases were planted on the south side of the field. This section proved of more than ordinary interest, and was a spectacular demonstration of the many troubles to which the potato crop is heir.

FIELD-PEA VARIETY TRIALS.

Sufficient seed to sow two areas of $\frac{1}{4}$ acre each with the Harrison's Glory and Marrow-fat varieties was treated with hot water and Semesan by the Field Mycologist. Sowing was carried out in September at 4 bushels per acre, with $1\frac{1}{2}$ cwt. superphosphate per acre. Germination was rapid and most satisfactory. Collar-rot discoloration appeared on the roots of a number of plants early in December, and spread to the stems during the ripening-period, but the damage was not very great, and even the affected plants podded well, Harrison's Glory yielding 68 bushels per acre.

Over one hundred selections were made from various varieties of peas grown in short rows. Trials will be put in hand with these selections next season.

BULL MOOSE LINSEED.

A number of single-plant selections were made of the Bull Moose variety of linseed, with a view to producing, if possible, a taller-growing strain. This variety is particularly valuable on account of its high yield on certain types of soil and the high percentage of oil that can be extracted. The selections gave excellent promise of success along the lines desired.

ALGERIAN OATS FOR SHEEP-FEED AND HARVESTING.

These were sown in March at the rate of 2 bushels per acre with 1 cwt. super per acre. The purpose of this crop was to provide winter and early spring feed for breeding ewes. There are differences of opinion regarding the actual feeding-properties of this crop, but there can be no doubt as to its usefulness for wintering failing-mouth ewes and furnishing spring feed for ewes and lambs. If grazed under damp conditions and when the growth is somewhat rank scald is frequently set up, and a large proportion of the ewe flock last season suffered from lameness from this cause. This crop was fed until the end of September and then closed up. It was harvested in January, and gave approximately 2 tons of chaff per acre.

LUCERNE.

The lucerne areas are still a strong feature of the farm. The carrying-capacity of the best fields for grazing was approximately 3.8 sheep per acre during the period 16th September until 14th January. Later grazing data are not yet available. The early summer months were wet and the stock did not do as well as usual. The first draft of lambs were not got away until February. A considerable quantity of lucerne hay has been saved, and will be used for the ewe flock during the winter period.

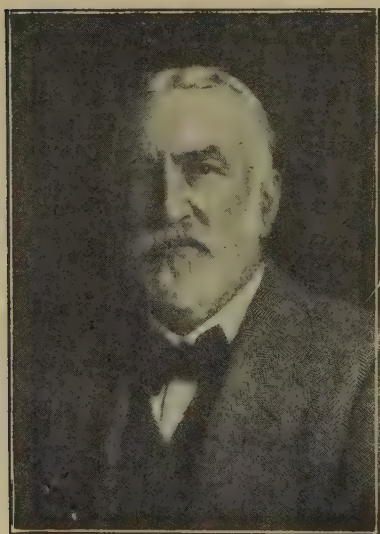
EDUCATIONAL, ETC.

A very successful farmers' field-day was held on 8th January last, when there was a representative attendance of two hundred farmers from various parts of Canterbury. A day was also set aside for the purpose of enabling merchants to see what has been done on the farm in connection with crop-improvement work.

The farm is also serving another useful purpose as a centre from which the Agronomist gives instruction to Instructors in Agriculture who are directly connected with the operations of crop certification.

THE LATE SIR JAMES WILSON.

THE *Journal* places on record its tribute to the memory of Sir James Wilson, who passed away full of years though still partially in harness, on 3rd May. Sir James was brought into specially close contact with the Agriculture Department through the Board of Agriculture, over which body he had presided since its inauguration in 1914. In this capacity his wide experience in public life, practical association with rural interests, and immense fund of agricultural information rendered him a most valuable adviser on many important questions arising



through the years. One of Sir James's strongest interests was that of agricultural education in all its forms—from farm instruction and demonstration to University course—and in this he was intimately associated with the late Edwin Hall. In 1925 he led the Board of Agriculture, together with representatives of the Agriculture and Education Departments and the University Senate, in a comprehensive survey of the question with reference to New Zealand conditions, the inquiry resulting in valuable recommendations to the Government. Another related activity was the chairmanship of the Commission appointed in connection with the Cawthron bequest, from which the Cawthron Institute of Scientific Research was evolved. Forestry as an interest allied to agriculture also claimed his keen support, and he presided over the

New Zealand Forestry League for a number of years. Sir James, who settled in the Lower Rangitikei district in the "seventies," remained an active farmer all his life. It is significant of his broad sympathies with the man on the land that he identified himself with the New Zealand Farmers' Union from its beginnings, and held the position of president of that organization for some twenty years. He had been aptly termed the Grand Old Man of rural New Zealand: the name of James Glenny Wilson will be writ large in our agricultural annals.

Wool Research.—Investigations were recently commenced at Massey and Lincoln Colleges on sectional problems of the sheep and wool industry. At the former institution Dr. Scrivener is pursuing a research into the relation of wool-yolk to environment and feed, and Dr. Dry is investigating problems connected with fleece development.

WHEAT-MANURING EXPERIMENTS IN CANTERBURY, SEASON 1928-29.

A. W. HUDSON, B.Ag., B.Sc., Crops Experimentalist, Fields Division.

AN outline of objectives of the Fields Division's wheat-manuring experiments was given in the *Journal* for May, 1928, in an article recording the results for the 1927-28 season. No alterations were made in the design of previous work, but a considerable extension was effected in the 1928-29 season. This was made possible by a larger staff, and better facilities for threshing the experimental plots. Experiments of the standard types, the treatments of which are shown below, were conducted on sixteen farms throughout Canterbury and North Otago, two experiments being laid down on each farm. Of the thirty-two trials, those on one farm in Canterbury had to be abandoned owing to the paddock having to be reploughed on account of heavy germination of wild oats, and those on three farms in North Otago were ruined by the severe hailstorm experienced there in January. Consequently only twenty-four experiments reached completion.

In Canterbury the trials were ably conducted by Instructors A. Y. Montgomery, R. A. Calder, and E. M. Bates, under Mr. R. McGillivray, Fields Superintendent. The North Otago experiments were efficiently carried out by Instructors A. A. Hume and T. Sellwood, under Mr. R. B. Tennent, Fields Superintendent.

Manurial Treatments.

The treatments used in the standard type of experiment are as follows, the quantity stated being at per-acre rate:—

Experiment type A—

- | | | |
|---|----|--------|
| (1) No manure. | .. | 1 cwt. |
| (2) Superphosphate (44-46 per cent. tricalcic phosphate) | .. | 1 cwt. |
| (3) Basic super (41-43 per cent. tricalcic phosphate) | .. | 1 cwt. |
| (4) Ephos phosphate (guaranteed 54 per cent. tricalcic phosphate) | .. | 1 cwt. |
| (5) Nauru phosphate (about 80 per cent. tricalcic phosphate) | .. | 1 cwt. |

Experiment type B—

- | | | |
|--|----|--------|
| (1) Superphosphate | .. | 1 cwt. |
| (2) Super 1 cwt., plus muriate of potash 1 cwt. | .. | 2 cwt. |
| (3) Super 1 cwt., plus nitrate of soda 1 cwt.* | .. | 2 cwt. |
| (4) Super 1 cwt., plus muriate of potash 1 cwt., plus nitrate of soda 1 cwt. | .. | 3 cwt. |

* The nitrate of soda was top-dressed in September.

One of each of this set of treatments was laid down on each farm under experiment, the trials being immediately alongside each other in the same field. Each treatment was replicated eight to ten times, and each plot divided into two at harvesting. As a result, up to twenty separate plots were harvested in each treatment. Solid-straw Tuscan wheat was sown in nearly all cases, the seed being treated with copper carbonate as a preventive for stinking-smut.

All results have been submitted to statistical examination, and where a difference in yield is indicated as being "significant" every

confidence can be placed in the results. A difference which is not significant must be viewed as though the yields of treatments under discussion were exactly alike.

Results of Type A Experiments.

The whole of the results of the type A experiments are set out in the following table:—

Table 1.—Data regarding Type A Experiments in 1928–29 Season.

Farmer and Locality.	Previous Crop (1927–28 crop mentioned first).	Date of Sowing Experi- ment.	Date of Harvest- ing.	Yields of Treatments in Bushels per Acre.					Increase over No- manure due to Super.
				No Manure.	Super.	Basic Super.	Ephos Phosphate.	Nauru Phosphate.	
(1) Ashworth Bros., Sefton	Grass for several years	17/7/28	2/2/29	35.7	49.5	44.5	37.9	36.9	13.8
(2) C. G. Amyes, Fernside	Ditto ..	8/7/28	6/2/29	40.4	50.8	45.9	43.1	42.2	10.4
(3) D. Mulholland, Dar- field	„ ..	13/7/28	11/2/29	39.0	46.9	45.4	43.5	43.4	7.9
(4) F. W. Carpenter, Preb- bleton	Wheat, peas, following grass	2/7/28	1/2/29	22.4	23.6	23.6	21.5	22.1	1.2
(5) L. Oakley, Rakaia ..	Grass for three years	27/6/28	6/2/29	64.8	66.6	63.1	64.1	63.6	1.8
(6) E. Body, Methven ..	Wheat following grass	22/5/28	11/2/29	52.3	54.3	54.2	53.1	52.7	2.0
(7) A. Amos, Wakanui ..	Ditto ..	3/7/28	7/2/29	48.1	51.0	50.9	49.8	50.0	2.9
(8) J. Bland, Winchmore	Grass for three years	25/6/28	4/2/29	60.0	66.4	63.0	62.1	62.0	6.4
(9) J. W. Topham, Aro- whenua	Potatoes, wheat, grass	14/6/28	4/2/29	51.1	58.1	57.6	53.4	52.8	7.0
(10) P. R. Talbot, Clare- mont	Rape, wheat, green feed, oats, grass	18/7/28	14/2/29	29.6	39.9	36.9	32.1	31.4	10.3
(11) D. Caird, Southburn	Grass for five years	16/7/28	15/2/29	29.2	35.5	34.0	32.8	30.7	6.3
(12) F. Saunders, Stud- holme Junction	Potatoes, oats, peas	5/7/28	12/2/29	32.4	36.2	35.0	33.8	33.7	3.8
Average yields				42.1	48.2	46.2	43.9	43.5	..
Average increases over no- manure				..	6.1	4.1	1.9	1.4	6.1

Remarks.

(Numbers refer to experiment numbers in table above.)

(1) (2) The yield from super is significantly better than that of any other treatment.

(3) (4) The yield from super is significantly better than that from any other treatment except basic super.

(5) The results of this experiment have not been examined statistically. Mr. Bates reports that the threshing-machine was working unsatisfactorily, and that in his opinion the results are of little value. He states that each of the super and basic super plots had one to one and a half more sheaves than the other treatments. Further, super and basic super plots ripened earlier than the others. These points are highly reliable indications of substantial increases in yield.

(6) The increases of both super and basic super over no-manure are the only significant differences.

(7) The yield from super is significantly better than those from no-manure and Ephos.

(8) The yield from super is significantly better than that from any other treatment.

(9) The yield from super is significantly better than that from any other treatment except basic super.

(10) (11) The yield from super is significantly better than that from any other treatment.

(12) The yield from super is significantly better than that from any other treatment except basic super.

COMMENTS ON TABLE I.

Each yield is the average of twenty plots, each of which was seven coulter rows wide by $1\frac{1}{2}$ chains in length (the length varied a little in different experiments). In the individual experiments only the increase in yield caused by super is shown. In Experiments 1, 2, 8, 10, 11, super shows significant superiority over all other treatments. In Experiments 3, 4, 6, 7, 9, 12, super and basic super are approximately equal in yield, and in the main superior to other treatments. In every case super has given a significant increase over no-manure.

The relative merits of the manures for the season under review can be seen at a glance at the foot of the table, and indicate quite clearly the advantages of super.

Some of these trials are particularly interesting as indications of seasonal variations (and possibly paddock variations) in response to manure. Experiment 4, on the farm of F. W. Carpenter, was conducted on the same field as last year's experiment. Last year super gave an increase of 8.1 bushels over no-manure; this year the increase is only 1.2 bushels.

E. Body's farm (Experiment 6) is less than a mile from J. McAnulty's, where last year's trial was conducted in this district. Last season's super caused an increase of 7 bushels; this year on Body's farm the increase is only 2 bushels.

Experiment 9, on J. W. Topham's farm, was conducted on a paddock alongside last season's trial paddock. Last year super gave no increase; this year the increase is 7 bushels.

Profit resulting from Use of Super.—Reckoning wheat as worth 5s. per bushel of increase (threshing and haulage charges, &c., must be deducted from market price) and super at 5s. per hundredweight, it is evident that an increase of 1 bushel is sufficient to meet the cost of the manure. (A small amount should be allowed for cartage and application.) The average increase of all experiments shows a net profit of approximately 25s. per acre, or something like 500 per cent. on the outlay.

Results of Type B Experiments.

The results of all these experiments are shown in Table 2 (next page).

COMMENTS ON TABLE 2.

The superphosphate-treated plot is used as the standard for comparison in each of the experiments, the results of which are discussed below. It is assumed that the super would have given the same increase over no-manure had the latter treatment been included, as it did in the adjoining experiment. This increase is carried forward from Table 1 and shown in the second-last column.

Effect of Potash as Addition to Super.—The column of yields of super plus potash shows that in only three trials has the potash caused a significant increase. Only one of these increases—that in Experiment 6—can be regarded as paying. The cost of 1 cwt. of muriate of potash is approximately 15s., so that a 3-bushel increase at least is required to meet the cost of the potash.

Table 2.—Data regarding Type B Experiments in 1928-29 Season.

(For experiment type A carried out in the same fields respectively, see corresponding number in Table 1.)

Farmer and Locality.	Number of Plots harvested in each Treatment.	Date of applying Nitrate of Soda.	Yields of Treatments, and Difference from Super (where significant) in Brackets below Yields.				Increase given by Super in adjoining Experiment A.	Increase of Super and Nitrogen over No-manure.*
			Super.	Super plus Potash.	Super plus Nitrate of Soda.	Super plus Potash plus Nitrate of Soda.		
(1) Ashworth Bros., Sef-ton	18	11/9/28	48.8	48.2	48.5	45.3 (-3.5)	13.8	13.8
(2) C. G. Amys, Fernside	20	6/9/28	47.8	47.9	53.8 (+6.0)	47.3	10.4	16.4
(3) D. Mulholland, Dar-field	20	10/9/28	41.7	40.5	47.9 (+6.2)	45.2	7.9	14.1
(4) F. W. Carpenter, Preb-bleton	18	10/8/28	16.8	18.2 (+1.4)	22.3 (+5.5)	23.0 (+6.2)	1.2	6.7
(5) L. Oakley, Rakaia ..	20	20/9/28	69.5	66.9	69.1	69.5	1.8	1.8
(6) E. Body, Methven ..	18	19/9/28	54.0	58.6 (+4.6)	64.8 (+10.8)	64.9 (+10.9)	2.0	12.8
(7) A. Amos, Wakanui..	19	27/9/28	52.2	51.2	59.9 (+7.7)	58.5 (+6.3)	2.9	10.6
(8) J. Bland, Winchmore	20	28/9/28	60.3	61.0	63.7 (+3.4)	63.1	6.4	9.8
(9) J. W. Topham, Aro-whenua	16	27/9/28	66.9	68.4 (+1.5)	72.4 (+5.5)	72.7 (+5.8)	7.0	12.5
(10) P. R. Talbot, Clare-mont	16	29/9/28	33.3	33.4	38.8 (+5.5)	38.5 (+5.2)	10.3	15.8
(11) D. Caird, Southburn	10	25/9/28	34.4	35.9	34.3	33.4	6.3	6.3
(12) F. Saunders, Stud-holme Junction	16	29/9/28	34.8	35.1	36.8 (+2.0)	35.9	3.8	5.8
Average increases over no-manure	..	..	..	..	..	..	6.1	10.5

* This represents the superphosphate increase shown in Experiment A added to increase due to nitrogen in Experiment B.

Remarks.

(1) Neither potash nor nitrogen used alone with super have affected the yield. When used conjointly with super the yield has been depressed by 3.5 bushels per acre.

(2) Nitrate of soda has caused an increase of 6.0 bushels per acre over super. Potash used alone with super had no effect, but when combined with super and nitrogen a definite depression to a yield just about equalling super has occurred.

(3) The same remarks apply as for No. 2, although the depression due to potash when used with super plus nitrogen is not so great, being 2.7 bushels. The depression is significant.

(4) The addition of potash to super has caused a small increase of 1.4 bushels. The addition of nitrate of soda has increased the yield over super by 5.5 bushels. The complete manure has not done appreciably better than super plus nitrogen.

(5) See No. 5 remarks under Table 1.

(6) Potash added to super has caused an increase of 4.6 bushels per acre. Super plus nitrogen is better than super by 10.8 bushels, but potash added to super plus nitrogen has failed to increase the yield.

(7) Nitrogen has caused a substantial increase of 7.7 bushels. Super plus potash does not differ significantly from super. Super plus potash plus nitrogen is significantly lower than super plus nitrogen by 1.4 bushels. Hence potash in the complete manure has depressed the yield.

(8) The addition of nitrate of soda has increased the yield above super alone by 3.4 bushels per acre. Potash has had no appreciable effect.

(9) A small increase has resulted from the addition of potash to super. Nitrogen added to super has caused an increase of 5.5 bushels. Potash added to super plus nitrogen has not improved the yield appreciably.

(10) Potash has not affected the yields. Nitrate of soda has caused an increase of 5.5 bushels per acre.

(11) There are no significant differences between treatments.

(12) The only significant increase over super is that caused by the addition of nitrate of soda.

It should be noted that the nitrogen in Experiment 6 caused an increase of 10.8 bushels, and although potash added to super has caused an increase of 4.6 bushels, when potash is used in conjunction with super plus nitrogen no benefit is derived from the potash, the yield from the complete mixture being practically the same as that from super plus nitrogen.

Effect of Top-dressing Superphosphate Plots with Nitrate of Soda.—In the column headed "Super plus Nitrate of Soda" it will be seen that in nine of the trials nitrate of soda caused significant increases, ranging from 2 to 10.8 bushels per acre, with an average for the nine of 5.8 bushels. If the whole twelve are averaged the increase is 4.4 bushels per acre. Nitrogen has been used on F. W. Carpenter's farm for four years in succession, and has caused an increase of between 5 and 6 bushels per acre in each season.

The cost of nitrate of soda at Christchurch during the past season was 18s. per hundredweight, so that just over 3½ bushels of wheat are required to pay for the quantity applied. Other forms of nitrogen will be on the market next season at a much lower cost, and it can be assumed that the price will be such as to be covered by the value of 2½ to 3 bushels of wheat (12s. 6d. to 15s.). Therefore any of the increases shown above which exceed 3 bushels per acre can be regarded as returning more than the cost of the nitrogen.

Using the averages shown at the foot of the two last columns, the following indicate the approximate financial position as a result of using (1) super, and (2) super plus nitrogen :

- (1) Value of 6.1 bushels increase from super at 5s. per bushel = 30s. 6d.
Cost of 1 cwt. super = 5s. ; net profit = 25s. 6d.
- (2) Value of 10.5 bushels increase from super plus nitrogen = 52s. 6d. Cost of 1 cwt. super = 5s. plus cost of 1 cwt. nitrogenous fertilizer (say), 13s. = 20s. ; net profit = 34s. 6d.

Effect of using Super, Potash, and Nitrogen.—The combined effect of the three fertilizers is interesting. In Experiments 1, 2, 3, and 7 significant depressions in yield below those given by super plus nitrogen have occurred as a result of using all three fertilizers. In Experiments 4, 6, 9, where potash used with super gave increases, the use of the three substances has in no case given a significant increase over super plus nitrogen. In Experiments 5, 8, 10, 11 there is no significant evidence of the benefit of using the complete mixture.

Experiments on Use of different Forms of Nitrogen.

The promise shown by nitrate of soda as a spring top-dressing brought about the necessity for investigation of the effects of other and cheaper forms of nitrogen. Consequently a start was made on two trials described on pages 342 and 343.

FARM OF J. F. DAWSON, FERNSIDE.

This experiment was laid down on 31st May, 1928, and harvested on 30th January, 1929. Variety of wheat, Solid-straw Tuscan. The previous crop was barley. The treatments used per acre were as follows :—

- (1) No manure.
- (2) Nitrate of soda (15.5 per cent. nitrogen) 1 cwt.
- (3) Superphosphate (44-46 per cent. tricalcic phosphate).. .. 1 cwt.
- (4) Super 1 cwt., plus nitrate of soda 1 cwt. 2 cwt.
- (5) Super 1 cwt., plus sulphate of ammonia (20 per cent. nitrogen) 87 lb. 199 lb.
- (6) Super 1 cwt., plus calcium cyanamide (19 per cent. nitrogen) 91 lb. 203 lb.

The quantities of nitrogenous fertilizers were arranged so as to supply equal amounts of nitrogen per acre. The super was applied with the seed, and the nitrogenous manures were top-dressed on 23rd August. The results are given in the following table :—

Table 3.

(Each yield is the average of 36 plots.)

Treatments.	Yields per Acre.	Increase over No-manure.	Increase of Super plus Nitrogen over Super.
	Bushels.	Bushels.	Bushels.
(1) No manure	25.3	..	..
(2) Nitrate of soda	26.1	0.8	..
(3) Superphosphate.. .. .	28.7	3.4	..
(4) Super plus nitrate of soda	29.6	4.3	0.9
(5) Super plus sulphate of ammonia.. .. .	30.8	5.5	2.1
(6) Super plus calcium cyanamide	31.7	6.4	3.0

NOTE.—Increases which are significant are shown in heavy type.

Comments on Table 3.—All treatments except nitrate of soda alone have given significant increases. The addition of nitrate of soda to super has not caused a statistically significant increase, although it is probably real enough. The addition of both sulphate of ammonia and calcium cyanamide to super has caused significant increases, and both Treatments 5 and 6 are significantly better than Treatment 4.



EXPERIMENTAL PLOTS ON MR. DAWSON'S FARM, FERNSIDE.

Photo taken just prior to application of nitrogen.

FARM OF D. SPENCE, SHERWOOD.

This experiment was sown on 31st July, 1928, and harvested on 9th February, 1929. The previous crop was turnips, which was preceded by three years in grass. The treatments used per acre were as follows :—

- | | |
|--|---------|
| (1) Superphosphate (44-46 per cent.) | 1 cwt. |
| (2) Super 1 cwt., plus nitrate of soda (15.5 per cent. nit.) 1½ cwt. | 2½ cwt. |
| (3) Super 1 cwt., plus sulphate of ammonia (20 per cent. nit.) 130 lb. | 242 lb. |
| (4) Super 1 cwt., plus Urea (46 per cent. nit.) 56 lb. | 1½ cwt. |

The quantities of nitrogenous fertilizer were arranged so as to supply equal quantities of nitrogen per acre. The super was sown with the seed, and the nitrogenous manures were top-dressed on 1st October, 1928. Results are given in Table 4.

Table 4.

(Each yield is the average of 29 plots.)

Treatment.	Yield per Acre.	Increase over Super due to Nitrogen.
	Bushels.	Bushels.
Superphosphate	19.9	..
Super plus nitrate of soda	30.0	10.1
Super plus sulphate of ammonia.. .. .	27.8	7.9
Super plus Urea	25.6	5.7

Comments on Table 4.—All increases due to nitrogen are significant. Both nitrate-of-soda and sulphate-of-ammonia treatments are significantly better in yield than Urea. The difference between nitrate-of-soda and sulphate-of-ammonia treatments is not significant.

GENERAL REMARKS.

The results set out in Tables 3 and 4 must be taken as reliable only for the particular conditions in each case. The fact that sulphate of ammonia is better than nitrate of soda in one trial and the reverse in the other, though not to a significant extent, indicates the nature of the variations likely to occur. Season and time of application are important factors to be considered. The former cannot be controlled, but the latter is a matter, among other things, for a great deal of investigation. The best time to apply nitrate of soda is not likely to be the best time to apply sulphate of ammonia or other form of nitrogenous fertilizer.

Demonstration of Effect of Nitrogen.

In order to focus the attention of wheat-growers on the use of nitrogenous fertilizers, and to demonstrate the advisability of farmers giving spring dressing with nitrogen a trial, a special scheme was adopted. About two hundred roadside paddocks were selected, as follows: (1) North of Rakaia River, approximately ninety; (2) between Rakaia and Rangitata Rivers, approximately fifty; (3) between Rangitata and Waitaki Rivers, approximately fifty; (4) North Otago, approximately ten. Small plots of 1 chain by ½ chain, situated

in a prominent place, were dressed with nitrate of soda and sulphate of ammonia alternately, at 1 cwt. per acre. Each plot was marked with a small notice-board.

At harvest farmers were requested to harvest small plots of somewhere in the vicinity of 1 chain by 7 coulter from the nitrogen-treated plots and from the adjoining untreated. A large number of farmers carried out the necessary harvestings, which were threshed with the Department's machine. The areas harvested in this way, fifty in number, were distributed as follows: (1) North of Rakaia River, forty-five; (2) between Rakaia and Rangitata Rivers, two; (3) between Rangitata and Waitaki Rivers, three; (4) North Otago, no facilities for threshing so none harvested.

Considerable errors occurred, due to differences in natural fertility of the soil, but the following data are probably not far from the truth:—

Average yield per acre of plots not treated with nitrogen	.. 32.4 bushels per acre.
Average increase on plots treated with nitrogen	.. 4.8 bushels per acre.

Of the fifty trials harvested, forty of the nitrogen-treated plots showed increases, while ten had yields below those of their corresponding plots without nitrogen. The average increase of 4.8 bushels per acre is in fairly close agreement with the increase from twelve carefully conducted trials shown in Table 2.

Summary.

(1) Superphosphate at 1 cwt. per acre has been responsible for increasing the yield of wheat in every one of thirteen experiments (including Dawson's, Table 3). The average increase over no-manure in twelve trials, as shown in Table 1, is 6.1 bushels per acre.

(2) Super has proved definitely superior to the other forms of phosphate used in a number of trials, and in no case has any other phosphate proved better than super.

(3) Nitrate of soda, top-dressed at 1 cwt. per acre on crop sown with super, gave increases in nine out of twelve trials. The average yield from the twelve trials was 4.4 bushels per acre better than when super alone was used. Other forms of nitrogen caused increases as shown in Tables 3 and 4. The increase due to nitrogen, expressed as the average of fifty small-plot trials, was 4.8 bushels, and in close agreement with that from the twelve trials mentioned above.

(4) Muriate of potash added to super gave significant increase in only three out of twelve trials. When used in conjunction with super and nitrate of soda it did not cause any significant increase, and in four cases actual depression in yield occurred.

The valuable assistance of farmers providing land and assistance in carrying out these trials is much appreciated. In addition to the officers mentioned at the beginning of this report the work of Instructors A. G. Elliott, W. Stafford, and K. Montgomery must be duly acknowledged. In the statistical examination of results Miss P. M. Woolf did her part expeditiously and well.

THE CARE OF DAIRY CALVES.

PREVENTION AND TREATMENT OF INTERNAL PARASITES.

J. E. McILWAINE, M.R.C.V.S., Animal Husbandry Section, Live-stock Division.

It often happens where an area is set aside as a calf-paddock for several seasons that sooner or later the calves depastured thereon show symptoms of parasitic trouble. Low-lying paddocks or those subject to flooding should never be used for calves, and overstocking, especially in the late summer and autumn, should be avoided. Where a paddock is known to harbour parasitic larvæ, radical measures should be adopted. The paddock requires to be vacated and ploughed, with a liberal dressing of lime. Drainage also assists considerably in low-lying paddocks.

The symptoms shown by parasite-infested calves are wasting, anæmia, coughing, and diarrhoea. Persistent coughing, with the tongue protruding slightly from the mouth, is characteristic of parasites in the bronchial tubes of the lungs. Cattle up to two years of age may be affected with the lung-parasite. In many cases young heifers which have not been well fed and cared for are suspected of tuberculosis, when lung-parasites are the cause of the coughing and other symptoms shown.

Several methods of treatment are adopted for the eradication of lung-parasites in calves, but it must be emphasized that the best treatment is prevention, and this can be effected by careful management and good feeding. Without extra feeding even medicinal treatment will not yield very satisfactory results; in fact, there is no time in the animal's life when good wholesome food of a productive nature will yield a more satisfactory return than when it is affected with parasites. The food recommended is a mixture of equal parts of crushed oats and linseed nuts, allowing 2 lb. per head per day until all symptoms of the disease have abated. Other feeding-stuffs such as bran or crushed peas and beans may be utilized, but in extensive trials crushed oats have given better results than most other feeds.

Among other forms of treatment practised is fumigation with volatile antiseptics and sulphur, and the injection of medicinal agents direct into the trachea. In some of our dairying districts a rather common practice is to pour a little chloroform or ether into the affected animal's nostril with the object of killing the worms in the bronchial tubes. The worms are later expelled by coughing.

When parasites are present in the stomach and intestines of calves, scouring is a frequent symptom in addition to an unthrifty appearance and anæmia. The animals are usually in poor condition, sometimes pot-bellied, and frequently weak and careless about feeding. Such was the condition of a herd visited by the writer in the early winter of last year. A post-mortem examination was carried out on an animal which had recently died. The parasites were so small that they could not be seen easily by the naked eye. A section of the bowel from the calf was forwarded to the Veterinary Laboratory at Wallaceville, and the report showed that numerous parasites were embedded in the bowel-wall.

The treatment adopted in this herd was weekly dosing with two tablespoonfuls of turpentine in half a pint of milk. The animals were already receiving a ration of hay, as green feed was scarce, and in addition a ration of equal parts of crushed oats and linseed nuts was advised, allowing 2 lb. per head per day. No further losses occurred, though the infestation was a severe one. Without the special feeding the animals would not have survived. A mere allowance of hay in such cases does not in itself supply enough nutriment to the body.

In parasitic trouble a change of pasture immediately after treatment and at frequent intervals is very desirable.

ABSENCE OF CORRELATION BETWEEN ABORTION AND TEMPORARY STERILITY IN DAIRY COWS.

C. S. M. HOPKIRK, Officer in Charge, Veterinary Laboratory, Wallaceville.

THE following analysis of results of a blood agglutination test on a Taranaki dairy herd shows the absence of correlation between the two diseases abortion and temporary sterility. Such a history is typical and is used as an illustration, being one of many similar cases noted.

In this herd there was a history of seven abortions and one retained membrane last winter and spring, and considerable temporary sterility in the past season. Sixteen cows held to first service, nineteen returned to more than one service, while five are still empty. Of sixteen cows affected with abortion eight held to first service, while eight unaffected cows also held. Of the nineteen cows returning to the bull, eight were reactors to the abortion test, seven were unaffected with abortion, while the blood of four cows was too broken down for a test to be made.

Two bulls were used—M and S. M got eleven calves for thirty services, and S got nineteen calves for fifty-two services. Both bulls were free from abortion trouble, and averaged only 35 per cent. efficiency. Bull M got seven cows in calf to first service, four of those being abortion-infected and three not infected. Of the eleven which returned to him five were affected with abortion, two were healthy, and with four the test was not known. Bull S put nine cows in calf at first service. Four were affected with abortion, and five were healthy. Eight cows returned to this bull—three affected with abortion and five negative

FERTILIZER SAMPLES FROM FARMERS.

FARMERS and other users of fertilizers are invited to forward to the Chief Chemist, Department of Agriculture, Sydney Street, Wellington, samples of any fertilizers they may purchase. Each sample should be of 1 lb. to 2 lb. weight, taken from a number of bags, and should be accompanied by the vendor's invoice certificate, showing the guaranteed composition, for comparison with the analysis. In case of a deficiency being shown by analysis, no action against the vendor will be taken in respect to any such informal sample, but arrangements will be made to collect official samples by an Inspector under the Fertilizers Act.

SEASONAL NOTES.

THE FARM.

PROVISION OF WINTER AND SPRING FEED FOR DAIRY COWS.

INADEQUATE winter and early spring feeding of cows is a common cause of low production in dairy herds. A cow calving in good condition and properly fed after calving will quickly reach her maximum production, whereas one calving in poor condition takes some time to reach her maximum yield of milk, for instead of converting her feed into milk she at first uses it to regain condition lost during the winter. Adequate feeding in the winter and spring is most important if a long high-producing lactation period is to be obtained from the cows.

In North Island dairying districts the modern tendency in grass farming is in the direction of close subdivision, heavy top-dressing, and the provision of supplementary feed for periods of grass shortage by means of hay and ensilage saved from the surplus summer production of grass. Cows in milk require feed rich in protein—that is, having generally a narrow nutritive ratio, such as young pasture grass. In order to provide sufficient protein-rich feed for the early spring it is usually necessary to save a considerable amount of the winter growth of grass by almost completely maintaining the cows during their dry period on hay, ensilage, and roots.

The autumn and early winter production of grass can be increased by the autumn top-dressing of pastures with phosphates, and early autumn top-dressing is becoming a feature of dairy-farm management. On rye-grass pastures the autumn and early winter growing-period usually extends to the end of June and July, while August and early September are months of normally poor growth of rye-grass. If dairy cows are to have a long, high-producing lactation period they must calve in July or early August, and the provision of young grass for early-calving cows from mid-July to mid-September is an important problem in dairy-farm management.

Grass from mid-July to mid-August can generally be obtained by shutting up some fields in June, catching the last of the winter growth of rye-grass, and holding this till the cows calve. Young grass from mid-August to mid-September can be obtained by the use of nitrogenous fertilizers, but whether the extended use of these for providing early winter feed is payable has not yet been definitely decided. In experimental work conducted during the past season the increase in the production of early spring grass from winter applications of nitrogenous fertilizers has been sufficiently satisfactory to warrant dairy-farmers trying them out on a small scale. The value of nitrogenous fertilizers in producing early spring feed can be best judged by shutting up two small fields in the winter, both of which have had the same phosphate treatment, and one in addition a dressing of nitrogen.

The efficacy of nitrogen in producing early spring feed varies considerably, depending on the type of pasture and moisture and shelter conditions of the field, and it is most efficient on well sheltered and drained fields the pasture of which is dominantly rye-grass. The best

time to apply nitrogenous manures in the winter has not yet been definitely determined, but it should be carefully borne in mind that there is no hope of the use of nitrogenous manures being a payable proposition unless the whole of the extra grass produced by them is turned into butterfat. Rye-grass pastures shut up in June will provide feed for cows calving in July, and applications of nitrogenous fertilizers to the fields shut up at this time will only be warranted if sufficient cows calve to use the whole of the extra grass-growth for milk production. The average farm is shortest of pasture feed from mid-August to mid-September; applications of nitrogen in July will increase the grass-growth at that period, and at present July would appear to be the most suitable month for the general application of nitrogenous manures. However, if the use of nitrogenous fertilizers in the winter is later shown to be a payable proposition, then the ability of the dairy-farmer to use them extensively for the stimulation of the early spring growth of grass will lead to the earlier calving of herds; hence the need for earlier applications of nitrogen, and June may be shown to be the month when the first winter applications should be made.

DRAINAGE.

June is a suitable month in which to finish the cleaning-out of all open drains and to carry out any tile-draining work that may be necessary. Before starting to tile-drain a field the plan of the proposed drains should be carefully worked out. The main line of tiles should follow the line of natural drainage where water collects. A parallel system of drains is suited to flat-lying land with a gentle slope in one direction. It is usually convenient to have the laterals running parallel to the fence-lines and to the "finishes," in order to give supplementary surface drainage in the same direction. Lateral drains should enter the main drain at an acute angle, and should in no case enter opposite sides of the main drain at the same point, but a few feet of space should always intervene, so that the flow of water in the main drains will not be checked by the meeting of two opposing currents. With a poor fall the lateral drains should not be more than 10 chains long; with a good fall—say, 4 in. per 100 ft.—they may be 15 chains. To efficiently drain very stiff clays the parallel drains may require to be 20 ft. apart; on moderately heavy soils 30 ft. to 60 ft. apart. Should springs be discovered in any part of the field it will be found advantageous to remove their water by special drains distinct from the regular system and at a greater depth, so that none of the spring water may be permitted to diffuse itself through the soil.

Tile draining is very costly, and many of the benefits of thorough drainage can be obtained less expensively by mole drainage. A strong, firm clay or loam, free from stones, offers the greatest facilities for mole drainage. It is essential that the subsoil be of even texture. The surface of the field need not of necessity be perfectly flat or even, for the mole-plough may be raised or lowered to some extent to suit the irregularities of the surface, but it must admit of a moderate and fairly uniform fall being given throughout the length of each drain.

The mole-plough consists essentially of a broad, flat coulter on the bottom of which is a pointed sock, and the mole which is attached to the bottom of the coulter behind the sock. The main drain is cut

in the ordinary way on the lower side of the field, and is usually laid in pipes. The main should be 6 in. to 9 in. deeper than the mole drains, so as to facilitate the discharge of water into it. The lines of the drains are usually 15 ft. to 30 ft. apart, and if the field has been ploughed in lands the drains are usually cut up the "finishes." When the main drain has been dug the mole is dropped into the open branch and drawn to the higher side of the field; when it reaches the end of the drain a pin is knocked out of one end of the coulter and the mole comes out of the ground. The plough is then drawn back to the lower side of the field and starts again at the next branch. A mole-plough will make about four miles of drains per day. In suitable soils the drains will last from fifteen to twenty years.

—*P. W. Smallfield, B.Ag., Fields Superintendent, Auckland.*

THE ORCHARD.

PRUNING OPERATIONS.

THE season having come round for the annual pruning the work should be proceeded with now, and every opportunity taken to push it forward in order to ensure its completion in good time. Too frequently one sees spring ploughing and cultivation, and even the earlier sprayings, delayed or omitted on account of the pruning operations being too protracted.

Pruning is only one factor in successful fruit-production, and although an important one in securing a balance between healthy wood-growth and normal fruit-production, it does not necessarily follow that success can be achieved simply by using judgment and skill in pruning. The other important factors more or less controllable by the orchardist—namely, soil-fertility, cultivation, disease-control, thinning, shelter, and drainage—must each receive due attention. It is only by thoroughness in each that a full measure of success can be secured.

The main objects in pruning are to establish a strong framework and secure a tree of good shape in the building-up of young trees, in older trees to help maintain vigour and regulate fruit-production, and to generally renovate old trees. Although much has been written about pruning and a vast amount of detail given, it is more or less confusing to a beginner. In every style or system two main principles must be adhered to—firstly, thinning out to secure good distribution of light and air; secondly, a shortening-in of various growths to maintain vigour and stability. The practice of pruning as applied to fruit-trees must necessarily be varied according to their age, vigour, variety, and condition generally. It resolves itself into a matter of exercising judgment in treating individual trees in the orchard after reviewing the previous season's results.

Stone-fruits.

Stone-fruit trees lose their foliage before pip-fruits and shoot into growth earlier, so it is wise to prune these first and secure the advantage of an early start. The various kinds of fruit differ in their fruiting-habit and so require varied treatment.

Peaches and Nectarines.—The fruiting-habit of the nectarine is identical with that of the peach. The peach bears its crop entirely on one-year-old wood, consequently it responds to correct pruning and readily declines with neglect. It is necessary to prune peach-trees more heavily than most other fruits in order to maintain a constant supply of fruit-bearing wood. Unless abundance of good vigorous shoots are produced each year a peach-tree may be considered to be in an unthrifty condition, and fruit-production is doubtful. The natural habit of the peach is to carry its bearing area higher each year, leaving unfurnished non-fruiting branches. The natural denseness of the peach-foliage makes it difficult to maintain a good distribution of fruiting-wood in the interior of the tree. Thinning out to ensure adequate light reaching all parts is necessary to ensure the production of fruiting branches on the lower limbs. Long laterals for fruit-bearing should be encouraged, and may be frequently shortened and renewed by cutting back to a new lateral. Trees should be thinned of superfluous branches to secure form, and fruiting-wood should be reduced considerably, so that the crop which is likely to set will be well distributed and will not be so heavy as to impose too heavy a task at thinning-time. It is generally more economical to reduce the crop as much as possible during pruning than entirely by hand thinning later. The reduction of fruiting-wood may be accomplished by thinning out. The heading-back of new shoots, especially on varieties which bear only on the tip or outer half, is undesirable. The proper amount of fruiting-wood should be obtained by thinning out unbranched one-year-old fruiting-shoots, and cutting back moderately to laterals fruiting-shoots that are branched. It is advisable to cut to well-ripened stocky laterals rather than to slender shoots.

Apricots.—The apricot produces the bulk of its fruit laterally on spurs which are relatively short-lived. A relatively small portion of the crop is produced on one-year shoots. The pruning system must be such as to cause the continual renewal of the fruit-spur system. Branches should not be allowed to become too long and unbranched. This condition may be avoided by cutting back to laterals. A fairly vigorous growth should be maintained, and as the tree becomes older and only short growth follows a thinning system of pruning, more severe treatment by way of cutting back may have to be resorted to in order to maintain the vigour of the tree.

Cherries.—Cherries are borne on long-lived spurs—ten to twelve years—consequently less renewal of fruiting-wood is required, probably less than on any other deciduous fruit-tree. Once the tree is brought into bearing little pruning is necessary to maintain it in a productive condition. The pruning which is necessary should be done annually, and should be of sufficient severity to renew approximately 10 per cent. of the fruit-bearing area each year. New growth is mostly from terminal buds; therefore, unless some heading is done, there is a tendency to develop long pole-like branches. Moderate cutting back of leaders for four or five years or until the framework is completed is necessary. Further heading will cause delay in fruiting, as encouragement to make shoot-growth by heavy cutting will render fruit-spur development impossible. Cherry-trees are particular as to conditions under which they will thrive. Reinvigorating of weak trees is not readily brought about

by the mere adoption of a sound pruning method. Proper soil-conditions must be maintained in order to keep a bearing cherry-tree in a good state of vigour. When cutting back is found necessary for any particular reason, care should be taken to cut to a lateral when possible. Trees showing die-back of leaders can sometimes be rejuvenated by severe pruning. It is imperative, however, that soil-conditions be improved at the same time.

Japanese Plums.—These plums are borne laterally upon short thick spurs, mostly on wood two years and older. A small proportion of the crop is produced on one-year wood, mostly at the base of strong shoots. The fruit-bearing habit is similar to that of the apricot, the principal difference being that the spurs on the Japanese plum are longer-lived. On account of their prolific bearing, and as only large fruits are of commercial value, fairly heavy pruning must be resorted to, in order to reduce the fruit crop and to induce sufficient growth of new wood.

European Plums.—European plums do not tend to overproduce as do the Japanese varieties, hence a lighter pruning with the idea of favouring bud-production is sometimes necessary, rather than a heavy pruning to reduce the amount of fruit-producing spurs. Most of the pruning would consist of removing worn-out portions and cutting out broken branches.

Notes on the pruning of pip-fruits will be provided for next month.

—N. J. Adamson, *Orchard Instructor, Hastings.*

Citrus - culture.

Shelter : This season's autumn weather conditions have been favourable to growth, resulting in citrus-trees being furnished with an abundance of new growth. There are few situations where this growth will not be affected by the rigour of the winter wind or frost. With adult trees the damage is not generally severe, though it pays to afford what shelter is possible by maintaining the shelter-belt in good order. Though it is most difficult to establish young undergrowth in an old shelter-belt, a breakwind of brushwood may be erected in the vacant spaces of the line and afford the required shelter. With young trees planted one or two years more local shelter is generally required. Where such cover-crops as lupins are grown these often afford the shelter required, but under other circumstances a wigwam of brushwood or maize-stalks should be built round the tree, open to the north-east and north and drawn together overhead. In unprotected places where damage from frost or cold wind occurs the damaged parts should not be cut away until the arrival of more open weather in the spring, for although they may be unsightly they afford some protection.

Drainage : During the rainy season every care should be exercised to ensure that no stagnant water is allowed to remain on or in the land.

Spraying : An application of 4-4-40 bordeaux is advisable at this time of year for verrucosis and grey scab on fruit and foliage. This spray also has the effect of hardening the foliage to better withstand low temperatures.

—W. H. Rice, *Orchard Instructor, Auckland.*

POULTRY-KEEPING.

THE BREEDING-HENS.

THE month of June may generally be regarded as one of the slackest periods in the poultry-keeper's year. Nevertheless there are several matters which will require attention, in addition to the ordinary routine work, if the stock and plant are to be maintained at a high standard of efficiency.

In the first place the prospective breeding-hens require to be specially fed and managed, in order that they may be in proper breeding condition at the time of mating. If good hatches and strong chicks are to be produced it is of the first importance that the hens are not allowed to become too fat. This does not imply that the birds should be placed on a starvation ration, but rather that they be fed according to their condition, and managed in such a way that they will not put on a surplus of interior fat. When hens are moulting, and until they are nearing a laying-point, they are usually disinclined to take much exercise. Thus, if they are provided with an abundance of food which can be secured with little or no effort, the formation of bodily fat will result.

This applies particularly after the birds have recovered from the moult. At this time they should be frequently handled for the purpose of ascertaining their condition. If they are found to be beyond a desired weight the only safe course is to provide a whole-grain ration, and in a manner which will compel the birds to exercise—that is, fed in a deep litter. Indeed, from now on until the termination of the breeding season the birds will retain a better breeding condition if the mash diet is entirely eliminated from the ration. This refers particularly to birds which are being kept under more or less confined, artificial conditions, for where a good range is available, particularly a free range, nothing better can take its place in providing healthy exercise and ideal conditions for breeding-stock. In all matters pertaining to breeding it is well known that nature's methods cannot be improved upon. Thus the best we can do with breeding-birds is to follow nature as closely as possible in the matter of feeding and management. If one could dissect a fowl's crop after a day on free range it would demonstrate nature's demands in feeding. We would not find any one particular class of food, but in most cases it would consist of a naturally balanced ration of different seeds, green stuff, worms, and various kinds of insect life.

Thus in cases where birds are being kept under confined conditions the ration should consist of a variety of whole grains. The greater the variety provided in this respect the greater will be the production of fertile eggs, the stronger will be the germs, and the more easy the chicks will be to rear. A chicken is made up of many constituents, and the food provided to the parent birds must contain these elements which are necessary for the formation of a properly developed chick. A variety of grains, an abundance of greenstuff, a spare ration of animal food, and provision for ample exercise are among the chief requirements for the maintenance of proper condition in the bird producing eggs for reproduction purposes. While there is little or no danger of overfeeding a heavy-laying bird with the right class of food, provided she is given an opportunity of taking plenty of exercise,

there is a grave danger of overfeeding the breeding specimen just before or when producing eggs for hatching purposes. Where market eggs only are being produced the birds can be forced with meat, milk, &c., and as a result the formation of surplus fat will be discouraged. Such treatment, however, would be a mistake where the breeding-bird is concerned, for if a highly forcing diet is provided trouble is almost sure to be experienced in the hatching and brooding operations.

For any other purpose for which fowls are kept I believe in feeding them well, but in the case of breeding-birds it may be necessary at times to depart from this rule. If they are putting on much surplus fat it will probably be found a wise course to slightly reduce the ration in order that they may be maintained in a more or less active lean condition.

THE BREEDING MALE.

While it is necessary that the hens should be maintained in the best possible condition, it is of equal importance that the male bird should be well treated, so that he may be in the best of form at mating-time. Usually male birds are more subject to infestation by lice than are hens, and are less likely to avail themselves of dust baths. For this reason they should be frequently dusted with insect-powder, or treated with Black Leaf 40 as recommended in a previous issue of the *Journal*. Male birds which carry large combs and wattles, which are common in such breeds as Leghorns, Minorcas, &c., should have these removed before being placed in the breeding-pens. As a result of this slight operation a bird will usually fertilize more eggs and produce much stronger germs. The operation can be simply performed by means of a pair of sharp scissors, a good dressing of iodoform being applied to the cut parts to prevent bleeding and other such after-effects. Long spurs on the male bird are another common cause of infertility of the eggs, and often result in hens having their sides badly ripped. The points of the spurs should be removed with a fine saw to within, say, $\frac{1}{2}$ in. of the shank, and if a little Stockholm tar is dabbed on the surface of the cut little or no bleeding will result.

PREPARING INCUBATORS AND BROODERS.

Another matter that should be attended to now is the careful examination of incubators and brooders to see that they are in thorough working-order. It may be found that fresh burners for incubator lamps are required, and new connecting-rods for the machines where the old ones have become bent, or set-screws which have become worn and liable to cause a serious accident at any time. A new thermometer to suit some special make of incubator may be required. Where these and other duplicate parts of incubators or brooders are required it is a mistake to leave the purchasing until the last minute. In point of fact, everything should be done to ward off possible trouble when the busy season arrives. Even for some of the most popular makes of incubators and brooders duplicate parts are not procurable in this country, and if these have to be brought from overseas it may easily mean an incubator or a brooder having to remain out of commission during the whole or part of the hatching season, merely because some essential is unprocurable when required.

—F. C. Brown, Chief Poultry Instructor, Wellington.

HORTICULTURE.

TOBACCO-LEAF.

A DISAPPOINTING feature in many tobacco crops of the past season was the number of blank spaces at harvest-time. A patchy crop of this class is a great economic waste, as it requires almost as much labour to handle it as an even crop. In some instances the blanks were filled late, with the result that that portion of the crop was unripe at the harvest period, and the labour was seriously increased and many difficulties created. In the great majority of cases this loss can be avoided with proper management.

One of the worst causes of this misfortune is the late and hurried preparation of grasslands for tobacco-culture. Where such lands are to be used the turf should be skim-ploughed now and cross-ploughed later when the turf has rotted. This early preparation exposes the larvæ and pupæ responsible for killing the young tobacco plants, and insect-eating birds, which are rather short of food at this season, follow the operation very closely, and do good work in cleaning up the pest. The capsules in which the insects lie dormant before emerging in the spring are also disturbed and destroyed, so that this ploughing, together with the cultivation which follows, effectively cleans the land of pests, as well as weeds, which embarrass the grower later if the tillage is neglected. This is the first important step in the production of a good tobacco crop.

Another matter requiring urgent consideration is that of shed accommodation for air-drying. Farm-sheds may be used successfully for the early crop, but they must be dry, or mildew will spoil the leaf. It takes about 10,000 cubic feet to house one acre of plants; thus a building 25 ft. by 16 ft. by 100 ft. should accommodate 4 acres of tobacco. This accommodation is the limiting factor of production, and it is important that this should be recognized, as much confusion will be avoided, and well-cured leaf may be obtained economically where this provision is well considered. Most farm-sheds are well ventilated, and serve the purpose for the early crops; for later use they are often too exposed for obtaining the best results without further protection of the stocks from the effects of cold and humid weather. Some iron buildings used are insufficiently ventilated for this purpose, which requires ample ventilation in the roof and also near the ground so that effective ventilation may be given as required. Most of the difficulties experienced in new districts would be avoided if sufficient and suitable provision of this kind were made.

PRUNING OF BUSH-FRUITS.

At the present time consideration should be given to the pruning of bush-fruits. It is a tiresome business, and it is often neglected. Gooseberry-bushes become overgrown with small berries and difficult picking results, while currant-bushes are allowed to grow high and the young wood is short and weak. In suitable districts these are profitable crops if a definite policy of pruning, spraying, and feeding is adopted. In both crops the best fruit is grown on the young wood, so the main principle in pruning is to preserve well-spaced young wood, and cut old wood well back to a bud that will provide young wood for another year. If this is done the bushes remain vigorous.

and the fruit is of good size and easily handled. As birds sometimes feed on the buds of these plants, it is customary to delay the actual pruning until late in the winter. In most districts pruning should be commenced towards the end of this month.

TOMATOES UNDER GLASS.

Towards the end of the month also another season commences for the tomato crop grown under glass. For this purpose a hotbed in a glass-house is generally used for starting the seeds. The hotbed should be made of fresh stable manure, and in these days of short supplies it is well to remember that the fallen leaves in shrubberies and plantations can be included. The heat, of course, is obtained from the fermentation of the material, and the amount of heat and the period will depend on its preparation. Very commonly the materials are placed in position as received, and the heat obtained is very little, unevenly distributed, and of brief duration. This is because the operation of fermentation is taking place in small patches and is checked on reaching dry material.

The full benefit of the method is obtained by setting up a steady fermentation throughout the whole mass before placing it in position. This is done by placing it in a compact heap to start the fermentation. In four or five days this will be established, and the heap should be turned over and shaken out to mix it, at the same time watering all dry portions as the work proceeds. After a similar period this operation should be repeated, and after about the same period has elapsed again the material should be evenly moist, and the bacterial action of fermentation should be in operation throughout the whole mass. It is then ready for building the hot-bed. Shake the material out and tread it down firmly. In about four days water the bed well and it is then ready for use.

A temperature of 55° to 60° F. should be maintained in the seed-boxes; covering them with a sheet of glass to retain moisture while the seed is sprouting is a very usual custom. A sheet of paper over the glass also provides useful shade.

PREPARING LAND FOR SPRING PLANTINGS.

In preparing the land for spring planting very deep ploughing has not always the results that are anticipated, and on land with a clay subsoil, or where such ploughing has not previously been practised, it is often better to follow the surface ploughing with a subsoil-plough, or the subsoil may be broken up to some extent by an attachment on the heel of an ordinary plough without bringing this lower stratum to the top. Certainly much land would be greatly improved for this purpose if it were deeply ploughed in this way more frequently. Preparation at this time affords an opportunity of turning in organic manures, and it is commonly done, but most of the large quantities of blood-and-bone manure used could also be applied and turned in deep at the present time with advantage. A good surface dressing of basic slag and kainit harrowed in after ploughing would be a good change of treatment for some lands and put them in good order by the time the spring planting season arrived. The surface is best left rough at the present time, especially in the case of stiff lands inclined to set or form a crust.

IMPORTANCE OF STRAIN IN SEED.

There is a demand for all classes of seeds, but the commercial grower should go to no end of trouble to get the best. Time, land, and labour are often spent in growing, say, a crop of cauliflower that does not pay for any one of those items of cost. Usually the variety is well chosen but the strain is poor. The experience and care spent in raising and maintaining high strains of seed is well worth the extra price, and no one renders a better service to the trade than seed-growers and distributors of this class. Seed potatoes of pure and sound quality have been notoriously difficult to obtain, but the Government - certificated seed that is now available affords a supply that every commercial grower should draw upon as far as possible.

—*W. C. Hyde, Horticulturist, Wellington.*

THE APIARY.

WINTER PRECAUTIONS.

BEFORE the cold weather sets in every hive should be examined, in order to make sure that the frames are completely covered with sufficient dry, well-fitting mats to keep the bees protected. Wherever a damp or mouldy mat is discovered it should be replaced with a dry one, and the roof examined and repaired. No draughts should be allowed around the frames. Mats made of corn-sacks cut to the exact size of a zinc queen-excluder answer all requirements of warmth. Be sure they are placed in their exact position. If placed crookedly the edges are apt to be pushed out between the hive-body and the roof, and will in time absorb enough moisture to make them damp and unwholesome.

Once more the time approaches when the necessity for shelter should impress itself on the beekeeper. It is most essential that the bees be protected from cold winds during the winter if they are expected to prove in normal condition in the spring. Should no permanent shelter be available, something temporary should be erected. Manuka scrub is excellent for making a temporary wind-break.

Weeds and grass should be kept down. A good clearing round the hives in autumn will suffice until spring, and will add materially to the comfort of the bees and the well-being of the hives. Not only should the entrances be cleared, but the ground all round the hives should be similarly treated, and the weeds raked up and destroyed.

TREATMENT OF WAX.

After the honey crop is disposed of and the bees are settled snugly in their winter quarters the beekeeper should give attention to clarifying his wax. Where a solar extractor has been used during the summer it will be a simple matter to collect the cakes of wax which have been melted in this manner and reduce them to one or two large cakes; but where a number of combs are to be treated a wax-press is an almost indispensable article in the apiary equipment. For handling wax in large quantities the press now known as the Root wax-press is best. No special building is needed for wax-melting; an ordinary washhouse answers the purpose admirably. Choose a cold day for the operation, since nothing excites the bees during the off season like the smell of hot wax.

Commencing operations, fill the copper half full of water, and when this is heated place the combs—which must have been removed from the frames—in the hot water. Have a strong stand ready to support the wax-press, and inside this place a kerosene heater, so arranging it that the flame comes in direct contact with the bottom of the press. Fill the water-compartment of the press with boiling water, which the heater will now keep boiling, and in the perforated basket of the press place a coarse scrim bag large enough to reach to the bottom of the basket. The combs in the copper should be stirred with a stick until the wax is all melted, and the contents of the copper—water and wax—should then be ladled into the scrim bag in the press. The top of the bag should now be folded, so as to allow of one or more of the wooden “followers” belonging to the press to be placed on top of it and the screw placed in position, when a stream of water and wax will immediately commence to flow from the outlet provided in the press. A kerosene-tin or similar vessel should be placed in position under the outlet.

Two precautions are necessary in using a wax-press. Pressure should at all times be applied with caution. Until the flow from the press slackens the screw should not be turned, and when it becomes necessary to apply pressure this should be done without appreciable effort. The screw should always turn easily. It will be found that if this advice is taken the maximum of wax will be obtained with very little risk to the machine. Another point to be borne in mind is that only a comparatively small quantity of water and wax must be put into the bag at each ladling. It is difficult to estimate exactly how much to treat at once, so much depends on the proportions of wax and water, but on no account attempt to fill the scrim bag at one operation. When the wax and water cease to run from the outlet the bag should be removed and the slumgum emptied out before the press is required to deal with any more wax. The wax should be set aside to cool as gradually as possible, this being best achieved by covering the tin containing it with corn-sacks or similar material. The gradual cooling helps to clarify the wax. When it is quite cold the cake should be taken out of the tin and carefully scraped.

The tin should now be washed out and partly filled with clean hot water, the cake of wax replaced, and the whole gradually heated until the wax is once more melted. After this second process the whole should be slowly cooled as before, and when the wax is once more removed and scraped it will have reached its commercial form. The wax-press and copper should be cleansed while still hot. The water should be emptied out of its compartment in the press at once, and the press placed to drain in order to prevent rust. The slumgum must be gathered up and burnt, and the bag washed and dried for future use.

BEEKEEPERS' CONFERENCE.

The annual conference of beekeepers will be held at Timaru on 5th and 6th June. Delegates from all parts of the Dominion will be present. Papers in connection with the Hopkins Memorial scheme will form a feature of the conference. This year's subject is “How to produce good queens of proved producing strain.” Arrangements have been made for an excursion to Mount Cook at the close of the conference.

E. A. Earp, Senior Apiary Instructor, Wellington.

REVIEW.

Minerals in Pastures and their Relation to Animal Nutrition. By J. B. Orr, D.S.O., M.C.M.A., D.Sc., M.D. London, 1929. H. K. Lewis and Co., Ltd. Price in Great Britain, 10s. 6d. From the Reid Library, Rowett Research Institute, Aberdeen.

THIS is a book which every well-read farmer should have on his bookshelf, for it is a painstaking attempt to bring together and set down in simple language all that is known in this difficult field of agricultural science. A very devoted band of high British experts, well known from their past efforts in the cause of agricultural science, is at present constituted, together with certain Government officials, as a sub-committee of the 1926 Civil Research Committee of the British Cabinet. The duty of this sub-committee is to consider and report on the relationship between the mineral content of pastures and their nutritive value. Among the members are Sir A. D. Hall, Sir Thomas Middleton, Professor T. B. Wood, and Dr. J. B. Orr. Major Walter Elliot, M.B., D.Sc., the chairman, is Parliamentary Under-Secretary of State for Scotland, and brings to the task of presiding over the committee much knowledge of a varied kind, for he holds medical and scientific diplomas, has had military and farming experience, and possesses a reputation for administrative ability. He is a skilful debater, and is always listened to with interest by that most critical of audiences, the House of Commons.

Major Elliot contributes a preface emphasizing the importance of research work into the mineral content of pastures, and indicates the steps the Imperial Government are taking to organize this investigation on an Empire-wide basis. This committee recommended that an important part of the investigation should consist of a search of the literature, and to collect and arrange in an easily accessible form all the available information bearing on the subject. The information having been printed was circulated to all workers in that branch and officials interested, and the present book is the result.

A pleasantly written foreword by Professor E. P. Cathcart, the well-known authority on nutrition, tells that Major Elliot's interest in the matter was first aroused by the high death-rate and disease in Highland sheep, which later was proved to be largely due to mineral deficiency in the herbage. Dr. Cathcart emphasizes the value of Dr. Orr's work, and concludes with the interesting thought that the antiquity of the phrase "the salt of the earth" testifies to the esteem in which the mineral constituents of nutrition have always been held. Dr. Orr in an opening note explains how he consulted other workers in writing this book, which he modestly terms a review, and how he has taken pains to visit most of the workers scattered all over the world in their own laboratories, research stations, and farms, and how much he has enjoyed getting into personal touch with the overseas researchers.

In the first chapter are given the reasons why this great team-work concerning minerals in pastures has been set on foot by the British Cabinet, supported by grants in aid from the Empire Marketing Board to workers in Britain, Australia, New Zealand, and East Africa. Pasture and its derivatives, hay and ensilage, are the main food of the domesticated herbivora. The amount of grassland products annually consumed in Britain is valued at £426,000,000, more than one-half of which products are imported. This amount is nearly one-quarter in money value of the total imports into Britain. The importance of the research to New Zealand is shown by the fact that of the great units of Empire the proportion of grassland products each one exports, expressed as percentages of the total exports of each, is as follows: Irish Free State, 55 per cent.; Australia, 60 per cent.; Canada, 17 per cent.; New Zealand, 94 per cent.

The importance of quality as well as of quantity in pasture is now becoming realized. Stock must have their pasture—their natural food—not only in sufficient bulk to provide for mere existence, but it should contain all the essential mineral foods in amount necessary to ensure maximum health, growth, and normal reproduction. What deficiencies of mineral foods occur and how they can best be remedied is the aim of this present crusade against ignorance.

Historical: As early as 1804 de Saussure came to the conclusion that the ash of plants varied with the nature of the soil and the plant's stage of growth. Later, Sprengel, in 1832, suggested that the ingredients of the ash of plants were of importance in the nutrition of animals. It is remarkable that these early investigators should have reached these conclusions which modern work is showing to be of fundamental importance in the nutritive value of pasture. The great systematic work done by Lawes and Gilbert (1856-1900) at Rothamsted included the chemical analysis of some thousands of samples of herbage, and brought out the important fact that "the mineral composition of the mixed herbage is very directly dependent on the supplies available within the soil. Indeed, the composition of the mixed produce was found to be a somewhat close reflection of the supply available within the range of the roots." Then in the latter half of the nineteenth century various European workers investigated the ash of hay grown in districts where endemic diseases occurred in herbivora, and more recently attention has been directed in South Africa, New Zealand, and Australia to pasture, sufficient in quantity, but which failed to sustain health or produce normal development in domestic stock. Later still came the combined attack by the Cambridge University Nutrition Institute and the Rowett Research Institute on mineral content of pastures, with reference to animal nutrition and disease (1925-26). Dr. Orr comments on the different objective of the Rothamsted analysis, on the one hand, and that of the other experimenters, on the other hand. Lawes and Gilbert experimented from the nutrition of the plant viewpoint, the others from the viewpoint of the animal for which the plant is grown. The distinction is very cogent, since the animal may suffer from mineral starvation when fed on normal quantities of perfectly healthy plants. Obviously the plant's requirements are not necessarily those of the animal. The *raison d'être* of pasture is to feed the animal; hence consideration of the animal should come first, and the pasture must be fed up to the animal's requirements or supplementary minerals fed to the animal. The percentages of minerals in different kinds of pasture are discussed from the animal's point of view—those elements present in the larger amounts in the ash, calcium, phosphorus, sodium, potassium, and chlorine; the protein and energy value; and finally the elements present in the rarer amounts—namely, iodine, iron, manganese, magnesium, sulphur, silicon, fluorine, boron, and copper—are passed under review.

Partial analyses are averaged, and the figures given for forty-eight samples of cultivated pasture expressed as percentages on the dry matter are found to compare with very highly manured and very poor deficient pastures in regard to the two chief minerals as follows:—

	Calcium Oxide. (CaO).	Phosphoric Oxide. (P ₂ O ₅).
Average of forty-eight cultivated pastures	1·104	0·765
Lord Astor's racehorse paddocks	2·473	0·997
Poor hill pastures (eaten)	0·560	0·600
Poor hill pastures (not eaten)	0·300	0·370
Very deficient pastures—		
Isle of Lewis	0·290	0·240
Falkland Islands	0·290	0·540

Pastures low in minerals tend to be low also in protein. There is no evidence of any correlation between caloric value and mineral content of pastures. On pastures in which there is extreme deficiency of one element deficiency diseases are most liable to occur.

One gathers from a study of the whole work of Dr. Orr that the only deficiency diseases in stock so far sufficiently authenticated to cause farmers serious concern are those caused by shortage of (1) calcium, (2) phosphorus, and (3) iron. In addition to these three elements there is the case of a possible excess of potassium—an element which is present in comparatively large amounts in all pasture in amount excessively large from the point of view of the animal, which has to eliminate the excess through the kidneys. It has been thought until recently that sodium applied as common or agricultural salt lick is required to assist this elimination, but recent work at the Rowett Institute has thrown some doubt on this supposed action of sodium.

On the necessity for giving salt as a lick to all domestic herbivora there is much better ground for dogmatizing. Both sodium and chlorine are essential mineral foods, and lack of a salt ration on the farm may result in the animal

suffering a temporary shortage when the pasture is deficient in sodium or chlorine. Chlorine appears to vary very much in pasture-samples. It is necessary in the formation of the acid gastric juice which contains dilute hydrochloric acid. The older writers and even the ancient classics extolled the use of salt, and suggested its influence in the general health and fecundity of animals. Conversely they attributed to the lack of it unthriftiness, diminished productiveness, and even, it is suggested, barrenness, or, as we should now say, temporary sterility. Apart from the use of sodium or chlorine, common salt is an excellent medium through which to give elements difficult to administer to stock such as iodine and perhaps iron.

It is sometimes difficult to induce sheep to take salt licks in New Zealand. Dr. Orr describes his pellet method of giving minerals to sheep, already described in this *Journal* and found to work satisfactorily in the two experiments tried locally (see issue for January, 1929, page 10). The method has been fully tried out in Kenya Colony and Scotland, and the results should be carefully studied by sheep-farmers on poor hill pastures. The following extract is taken from the book under review:—

"Kenya results: A mixture of inorganic salts supplying chiefly calcium, phosphorus, sodium, and chlorine, and traces of other minerals, has been fed to sheep and lambs grazing on pasture known to be deficient in these minerals. The following table shows the effect of the minerals on the rate of growth of lambs. There were forty-five lambs in each group. The group forming the control received no mineral supplement, while the other group was fed a mineral mixture at the rate of half an ounce per head per day.

	Control.	Mineral Mixture.
Molo (seven months), average gain in weight in pounds	14.3	18.2
Naivasha (nine months), average gain in weight in pounds	39.7	44.2

The average weight of the fleeces of the mineral-fed lot were in the one case (Molo) about 4 per cent. and in the other 18 per cent. heavier than in the controls. Somewhat similar tests have been carried out with sheep in Scotland grazing on areas in which the chief deficiency was calcium. These tests, however, are not strictly comparable in so far as, for convenience in feeding, the minerals were made up into the form of little cubes with protein-rich substances and 5 per cent. cod-liver oil. The cubes consisted of minerals to the extent of 50 per cent., and half an ounce per ewe per day was fed for the seven months in the year when the mineral content of the pastures was known to be at its lowest. The following figures show the weight of lambs at birth at the various hill farms; there were from fifty to a hundred lambs in each group.

Weight of Lambs at Birth.

	Fed.	Control Unfed.
Blairmore, Arran	7.4 lb.	7.1 lb.
Benlester, Arran	8.7 lb.	7.7 lb.
Essiehill, Rowett Institute	9.5 lb.	8.7 lb.
Edgerston, Single	9.0 lb.	8.5 lb.
Edgerston, Twins	7.3 lb.	7.2 lb.

"The influence on the weight of the fleece is shown by the following table:—

Weight of Fleeces.

	Fed.	Control Unfed.
Blairmore	4.3 lb.	4.2 lb.
Benlester	6.0 lb.	5.5 lb.
Edgerston ewes	4.6 lb.	4.2 lb.
Edgerston hoggets	4.8 lb.	4.3 lb.
Watcarrick	3.7 lb.	3.3 lb.
Terrona	3.8 lb.	3.5 lb.

"The results of these Scottish tests, therefore, are closely similar to those obtained from Kenya Colony."

The important thing to remember is the comparative cheapness of the direct mineral-feeding to sheep, and after a preliminary training of some of the sheep the pellet method is easy to manage.

More wonderful still are Brünnich's results in Queensland, where, under droughty conditions, a lick was made up to a prescription dictated by the mineral deficiency of the pastures as found by chemical analysis. Each sheep consumed $1\frac{1}{2}$ oz. of a phosphorus-rich salt lick per week, the result being in one large station that the stock carried during the drought period was doubled and the animals were in better condition, as evidenced by decreased mortality and increased percentage of lambing.

The book is well printed, and readers will find it a mine of information. There is a copious bibliography attached to each chapter, and the subject is treated from many angles. After the introduction, (1) the mineral content of pastures, (2) the factors affecting it, (3) the conditions favouring deficiency, and (4) the distribution of deficiency diseases are considered in subsequent chapters. The matter is treated geographically, a chapter being devoted each to Europe, Africa, Australasia, America, and Asia. Horses are considered in a tenth, methods of increasing the mineral food of animals in an eleventh, and the whole is summarized in a twelfth chapter.

B. C. A.

WEATHER RECORDS : APRIL, 1929.

Dominion Meteorological Office.

GENERAL NOTES.

THE general character of the weather experienced in April over the North Island and the northern and eastern districts of the South Island may be described as dull and moist with, in most districts, an absence of strong winds. In Westland, Otago, and Southland, on the other hand, it was fine, clear, and pleasant for the greater part of the month.

The total rainfall was below normal over the South Island, except in the north-east portion, and deficiencies were recorded also in the central districts of the North Island. In Marlborough and Nelson Provinces the falls considerably exceeded the average, as also was the case in the northern and eastern districts of the North Island.

Although temperatures were slightly below normal there were no extremes, and frosts were few and usually of only slight intensity. As a result, the growth of pasture was remarkable in all districts for the time of year. The prospects of good supplies of feed in winter are, therefore, everywhere bright. Stock has kept in good condition, but the soft state of the grass, owing to excessive moisture, has prevented the fattening of sheep in some parts of the North Island.

A characteristic of the month has been the frequency with which cyclones have controlled the meteorological situation, and the almost total absence of the westerly type of pressure distribution. Two of the cyclones had noteworthy features and may be briefly described.

The first, which was the one that caused serious floods in Tasmania about the 5th, moved very slowly in a north-east direction across the Tasman, and by the 8th was centred between Norfolk Island and Cape Maria van Diemen, where it remained stationary for several days. On the 11th it had passed east of Cape Maria van Diemen, and then moved gradually southwards off the east coast until the 14th. From the 8th to the latter date much dull, misty weather prevailed. Temperatures were mild until the 13th, after which southerly wind became general and temperatures fell rapidly. Rain was fairly widespread during this period, and many heavy falls occurred in the northern and east-coast districts of the North Island. Some flooding was experienced in the East Cape area.

On the 27th another cyclonic disturbance developed south-west of Norfolk Island. It increased rapidly in extent and intensity as it moved southwards, and by the 28th pressure had fallen to below 29 in. at many places in New Zealand. Special warnings of stormy weather and the likelihood of flood rains were issued on this date. The movement of the storm-centre was slow until the morning of the 29th, when it was situated west of Farewell Spit. Thereafter it moved rapidly across the northern portion of the South Island, and by the evening of the 30th had disappeared to the south-eastwards of the Chatham Islands. General heavy rains were associated with this disturbance, and considerable flooding resulted in the Nelson and Marlborough Districts. In Nelson City the flood was

the worst experienced in the past twenty years. Over the northern half of the North Island strong north-east to northerly gales were experienced. Generally, however, the winds were less severe than might have been expected in view of the fact that the cyclone was one of the most intense experienced in recent years.

—*Edward Kidson, Director of Meteorological Services, Wellington, 6th May, 1929.*

RAINFALL FOR APRIL, 1929, AT REPRESENTATIVE STATIONS.

No.	Station.	Total Fall.	Number of Wet Days.	Maximum Fall.	Average April Rainfall.
<i>North Island.</i>					
		Inches.		Inches.	Inches.
1	Kaitaia	4·87	15	1·50	3·55
2	Russell	6·60	11	1·90	3·59
3	Whangarei	9·99	14	2·91	4·45
4	Auckland	4·62	19	0·99	3·46
5	Hamilton	3·62	11	0·91	3·86
6	Kawhia	2·96	12	0·76	4·64
7	New Plymouth	5·80	16	2·42	4·51
8	Riversdale, Inglewood	5·38	14	2·17	8·39
9	Whangamomona	5·01	12	1·16	6·62
10	Eltham	8·14	11	3·20	5·16
11	Tairua	5·72	14	1·22	6·33
12	Tauranga	4·53	13	1·18	5·08
13	Maraehako Station, Opotiki	6·80	10	2·04	4·57
14	Gisborne	8·73	20	1·76	4·20
15	Taupo	3·40	10	1·27	3·77
16	Napier	3·71	19	1·25	2·92
17	Maraekakaho Stn., Hastings	5·10	21	1·55	3·14
18	Taihape	1·54	11	0·48	3·15
19	Masterton	3·92	18	0·87	3·04
20	Patea	4·02	12	1·23	3·59
21	Wanganui	1·64	5	0·87	3·37
22	Foxton	1·08	5	0·81	2·47
23	Wellington (Karori Reservoir)	7·25	16	3·75	3·80
<i>South Island.</i>					
24	Westport	2·15	10	0·85	6·50
25	Greymouth	2·81	8	1·51	8·37
26	Hokitika	2·89	14	1·26	9·38
27	Ross	2·82	6	1·63	12·55
28	Arthur's Pass	2·08	4	1·23	16·16
29	Okuru, Westland	1·58	5	0·92	13·67
30	Collingwood	8·89	13	2·56	8·07
31	Nelson	9·11	13	4·26	2·93
32	Spring Creek, Blenheim	6·12	11	3·78	1·72
33	Tophouse	6·59	9	1·83	4·22
34	Hanmer Springs	3·87	14	0·85	2·99
35	Highfield, Waiau	4·44	10	1·18	2·66
36	Gore Bay	4·26	10	1·33	1·77
37	Christchurch	1·48	12	0·60	1·97
38	Timaru	1·48	10	0·84	1·51
39	Lambrook Station, Fairlie	1·94	7	0·92	1·95
40	Benmore Station, Clearburn	1·34	8	0·80	2·55
41	Oamaru	1·53	9	1·02	1·78
42	Queenstown	1·31	5	0·90	3·00
43	Clyde	1·08	5	0·68	1·34
44	Dunedin	1·92	11	0·97	2·82
45	Wendon	0·61	5	0·40	3·16
46	Gore	0·74	8	0·35	3·15
47	Invercargill	1·10	10	0·31	4·36
48	Puysegur Point	4·73	12	1·14	7·98
49	Half-moon Bay	1·56	10	0·46	5·29

GOVERNMENT CERTIFICATION OF SEED-POTATOES.

PROVISIONAL CERTIFICATES ISSUED FOR SEASON 1928-29.

FOLLOWING is a list of growers who have received provisional certificates in connection with the certification of their seed-potatoes in the past season. Provisional certificates are issued with the object of affording growers some indication of the general standard of their crops, and assisting them in the disposal of their seed. Certificates and certification tags are issued later, provided an officer of the Agriculture Department inspects the graded seed-potatoes, and is satisfied that they are still of the same standard in regard to purity and freedom from disease as was indicated by the field inspection.

Aucklander Short-top :—

	Acreage.
L. R. Bell, St. Andrew's, South Canterbury	2
F. Brundell, "Camside," Kaiapoi, North Canterbury	5
W. Eder, R.M.D., Sefton, North Canterbury	11
J. Jellie, Russley Road, Fendalton, Christchurch	3
C. H. Jordan, R.M.D., Kaiapoi, North Canterbury	3
W. E. Martin, R.M.D., Kaiapoi, North Canterbury	15
A. J. Rich, R.M.D., Kaiapoi, North Canterbury	16
J. Rouse, Pareora, Timaru	1
L. Seyb, Washdyke, Timaru	1½
R. Smith, R.M.D., Kaiapoi, North Canterbury	5
Weeber Bros., Englefield Road, Belfast, North Canterbury	4

Aucklander Tall-top :—

J. Bailey, R.M.D., Kaiapoi, North Canterbury	7
D. Hewitt, Woodend, Kaiapoi, North Canterbury	3
J. D. McMullan, Elmwood, Kaiapoi, North Canterbury	5
L. Seyb, Washdyke, Timaru	1½

Dakota :—

E. S. Barnes, Hinds, Lowcliffe, R.M.D., Mid-Canterbury	2
James Carr, Mount Hutt, R.M.D., Rakaia, Mid-Canterbury	1
W. J. Crozier, Mount Hutt, R.M.D., Mitcham, Mid-Canterbury	3
Doak Bros., R.M.D., Rangiora, North Canterbury	12
P. J. Gill, Box 11, Kirwee, North Canterbury	1
George Hurst, Overdale P.O., Rakaia, Mid-Canterbury	6
H. M. Marshall, R.M.D., Weedon's, North Canterbury	2
W. McLachlan, Hills Road, Leeston, Canterbury	10
W. A. McPhail, Mitcham, Mid-Canterbury	14
E. A. Smith, Lincoln, North Canterbury	15
E. Thompson, R.M.D., Rolleston, North Canterbury	12
C. E. Walker, jun., R.M.D., West Melton, North Canterbury	3

Breeze's Prolific :—

James Carr, Mount Hutt, R.M.D., Rakaia, Mid-Canterbury	2
W. Chappell, R.M.D., Killinchy, Canterbury	7
D. Marshall, R.M.D., Killinchy, Canterbury	40
L. J. Palmer, Southbridge, Canterbury	5

Arran Chief :—

L. R. Bell, St. Andrew's, South Canterbury	3
Fraser Bros., Southbrook, Rangiora, North Canterbury	7
G. Jones, Vale Royal, Halswell, Christchurch	4
A. Mortland, Templeton, North Canterbury	5
D. Priest, Cave, South Canterbury	1
F. A. Rollinson and Sons, Studholme Junction, South Canterbury	8
E. E. Saunders, Studholme Junction, South Canterbury	7½
F. Saunders, Studholme Junction, South Canterbury	5
J. W. Smith, 103 Ilam Road, Fendalton, Christchurch	3

Up-to-date :—

P. J. Gill, Box 11, Kirwee, North Canterbury	1
F. McNae, R.M.D., Courtenay, North Canterbury	1
J. R. Robinson and Co., 184 Cashel Street, Christchurch	4
C. E. Walker, jun., R.M.D., West Melton, North Canterbury	6
F. Westaway, R.M.D., Courtenay, North Canterbury	8

			Acreage.
<i>Epicure</i> :—			
D. Marshall, R.M.D., Killinchy, Canterbury	..	..	4
G. McLachlan, Southbridge, Canterbury	..	..	4
E. W. Mote, 98 Grant's Road, Papanui, Christchurch ..	..	..	1
W. Shellock, Mead Settlement, Rakaia, Mid-Canterbury ..	..	..	2
L. T. Wright, Annat, North Canterbury	..	..	1
<i>Endurance</i> :—			
R. G. Bishop, R.M.D., Southbridge, Canterbury	..	..	1
W. J. Bishop, R.M.D., Southbridge, Canterbury	..	..	1
R. A. C. Burns, "Ken Burn," Rakaia, Mid-Canterbury ..	..	..	1½
<i>Early Regent</i> :—			
W. Eder, R.M.D., Sefton, North Canterbury	..	..	20
W. S. Kelly, 502 Lincoln Road, Halswell, Christchurch ..	..	..	3
<i>Majestic</i> :—			
A. J. Clark, Box 34, Rangiora, North Canterbury	..	..	2
W. J. Tozer, Davey Street, Temuka, South Canterbury ..	..	..	3½
<i>Great Scott</i> :—			
E. W. Mote, 98 Grant's Road, Papanui, Christchurch ..	..	..	1
A. Spillane, John Street, Temuka, South Canterbury ..	..	..	1
<i>Golden Wonder</i> :—			
G. E. Benny, R.M.D., Southbridge, Canterbury	..	..	1
S. Kokay, Tuatapere, Southland	..	..	2½
<i>Field-Marshal</i> :—			
L. T. Wright, Annat, North Canterbury	..	..	7
<i>Brownell's Beauty</i> :—			
F. McNae, R.M.D., Courtenay, North Canterbury	..	..	1
<i>Northern Star (Gamekeeper)</i> :—			
Hayman Bros., Willowbridge, South Canterbury	..	..	12
<i>King Edward</i> :—			
R. Knibbs, McNab, via Gore, Southland	..	..	1½

—Fields Division.

INVENTIONS OF AGRICULTURAL INTEREST.

APPLICATIONS for patents, published with abridged specifications in the *New Zealand Patent Office Journal* from 21st March to 2nd May, 1929, include the following of agricultural interest :—

No. 62000 : Milking-machine ; J. G. Lamb, Melbourne, Vic. No. 60173 : Portable bail for dehorning cattle ; S. Armstrong, Tuhikaramea, Frankton Junction. No. 60681 : Self-clearing harrow ; D. A. Dunn, Gore. No. 62068 : Feed-bin for milking-shed ; A. M. Bisley, Hamilton. No. 62116 : Milk-can ; W. Harvey, Auckland. No. 59566 : Indicator of yield of milk from cows ; E. Marsden and A. J. C. Woodward, Wellington. No. 60631 : Animal ointment ; Violet H. Lee, Auckland. No. 61843 : Cream ; J. E. Nyrop, Copenhagen, Denmark. No. 62017 : Sterilizing double cream ; S. Grasse, Glasgow, Scotland. No. 62175 : Noxious-weed destroyer ; W. H. Clarkson, Otahuhu. No. 62340 : Planting-machine ; I. Pomieraniec, London, England. No. 57999 : Milking-machine pulsator ; H. H. Sutton, Waihi. No. 62344 : Egg-case filler pad ; R. W. Burrows, Sonoma, U.S.A.

Copies of full specifications and drawings in respect of any of the above may be obtained from the Registrar of Patents, Wellington, price 1s. prepaid.

The Ragwort-moth.—At last month's meeting of the Council of Scientific Research the Chairman stated : " Good reports are to hand regarding the damage done to ragwort by the larvæ of *Tyria jacobææ*. It is hoped that there will be a good emergence of moths in the fields next year, and that large supplies of eggs will be available for distribution throughout the ragwort areas. Apparently a big factor in the ultimate success of ragwort destruction with this moth will be the mass distribution of large supplies as early as is possible in the next season, before parasites have an opportunity of establishing themselves on the *Tyria* itself."

ANSWERS TO INQUIRIES.

IN order to ensure reply to questions, correspondents must give their name and address, not necessarily for publication, but as a guarantee of good faith. Letters should be addressed to the Editor.

TREATMENT OF GREASY HEEL ON HORSE.

C.O.B., Tauranga :—

Would you let me know if there is a cure for greasy heel on a horse? I have a horse badly affected. I bathe the part in salt water every day. The fetlock is swollen, and has large grape-like lumps of a greyish-blue colour. Could they be burnt off?

The Live-stock Division :—

The cure of an old-standing case of grease, when "grapes" have formed, is not an easy matter. First of all, the parts should be thoroughly cleansed with hot water and soap, after which the hair on the edges of any cracks should be clipped off. A wet bran poultice to which has been added some disinfectant should be packed down into a bag fitted round the coronet and reaching up over the fetlock, where it should be tied. This poultice should be kept wet with hot water at intervals for one day. After the parts have become softened and properly cleaned up, water should not be applied again unless necessary to clear away dirt or to soften any scabs which may have formed. When swabbed dry, iodine ointment should be applied to any cracks or raw surfaces for a few days until these lesions look nice and healthy. After this a drying-agent should be employed, and a good one to use will be zinc-oxide ointment, which should be applied frequently with the aid of wads of tow or cotton-wool, which are kept in position by bandages. The "grapes" may be burnt off with a blacksmith's fire-shovel which has been sharpened, but this should not be attempted if the bases of the "grapes" are large in extent and big wounds likely to result. It would be advisable to burn off only one or two at first. A good caustic agent, such as equal parts of powdered bluestone and lard, applied to the "grapes" will probably be the best treatment for reducing them. This dressing may be repeated every day or two until the growths are sufficiently reduced. All precautions should be taken to keep the affected parts dry and clean.

MIXING OF SUPERPHOSPHATE AND BASIC SLAG.

"BUSH FARMER," Otorohanga :—

I should be obliged for any information concerning the mixing of super-phosphate and basic slag for broadcasting on hill country. Has the heating process which takes place after these manures have been mixed and left awhile any detrimental effect on either?

The Fields Division :—

The effect of mixing these fertilizers together is that the water-soluble phosphate in super is reverted to a form insoluble in water but quickly available to plants. The mixture is quite good for top-dressing hill country, but the fertilizers must be mixed in the paddock and applied immediately after mixing. If the mixture is left it sets hard like concrete.

PASTURE TOP-DRESSINGS.

F. J. CARTER, Rangataua :—

We have been doing a large amount of top-dressing with lime and super-phosphate mixed in about equal quantities. We use about 2 cwt. per acre, and find we are getting good results. The trouble is that the cost of mixing and handling seems excessive. Would as good results be obtained by the use of basic

superphosphate? How does the amount of fertilizing ingredients in basic super compare with that in superphosphate? Our country is light loam, situated at Karioi.

The Fields Division :—

You should get better results from 2 cwt. of basic super than 2 cwt. half lime half super. The first cost will be more, but the results should give a greater return for the expenditure. Basic super is usually made up of twelve parts super, four parts Nauru or other rock phosphate, and four parts carbonate of lime. We would suggest (1) that you apply about 5 cwt. of lime per acre in one dressing, and then apply super annually for three or four years; then repeat the dressing of lime; (2) that you use half super and half Nauru, or alternatively (3) basic super. Present results indicate that the half super half Nauru mixture will be the most economic fertilizer for your land.

RAISING WALNUT-TREES.

"WALNUT," Okaiawa :—

Would you please advise me how to grow walnuts from nuts. Can they be sown in tins or boxes and planted out when ready? When is the best time to sow, and how long do they take to come up? Should glass be laid over the top of the box?

The Horticulture Division :—

To grow walnut-trees from seed, selected nuts should now be mixed with sand or friable soil in a cool place, and allowed to remain there until the spring. They should be collected and planted out in a piece of good land during the month of August, 12 in. to 18 in. apart and 2½ ft. between the rows, covering the nuts with 2 in. to 3 in. of soil. In the following autumn after the leaves have fallen the young trees may be lifted and planted out. At this operation the extremity of the tap-root should be cut off to induce a growth of fibrous roots. As an alternative, the nuts may be sown where the trees are to remain, but in that case, while they will make larger trees, they will be much slower in bearing a crop.

FERTILIZER IMPORTATIONS: MARCH QUARTER.

FOLLOWING are the importations of fertilizers into New Zealand for the three months ended 31st March, 1929 :—

Sulphate of ammonia : United Kingdom, 230 tons; Australia, 10 tons; United States, 228 tons. *Calcium cyanamide* : Norway, 2 tons. *Nitrate of soda* : Netherlands, 50 tons; Chile, 885 tons. *Basic slag* : United Kingdom, 3,550 tons; Belgium, 30,845 tons; France, 35 tons. *Bonedust* : India, 75 tons. *Rock phosphate and guano* : United Kingdom, 10 tons; Seychelle Islands, 4,072 tons; Nauru, 23,079 tons; Makatea, 8,330 tons. *Superphosphate* : Belgium, 50 tons. *Phosphates (other)* : United Kingdom, 150 tons; Belgium, 10,768 tons; Morocco, 7,609 tons. *Kainit* : France, 260 tons; Germany, 57 tons. *Sulphate of potash* : France, 187 tons; Germany, 96 tons. *Potash manures (other)* : Belgium, 25 tons; France, 731 tons; Germany, 785 tons. *Sulphate of iron* : Australia, 5 tons. *Manures (other)* : United Kingdom, 6 tons; Germany, 53 tons; Norway, 1 ton.

Rearing of Young Stock.—In the care and management of young stock nothing is more essential than a plentiful and nourishing food-supply. A maintenance ration can be given to an adult animal in a time of food scarcity without detrimental effect, but not so in the case of young stock. For the latter a ration is necessary containing a liberal percentage of proteins (flesh-formers). As the adult stage is reached less protein and more carbohydrates (starches) can be given.—*Live-stock Division.*